The Welding Engineer

Founded by L. B. Mackenzie, 1916

JANUARY, 1926 VOL. 11, No. 1

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Published on the 15th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,

608 S. Dearborn St., Chicago, Ill.

Telephones Wabash 7134 and 7140

G. H. Mackenzie.....President and Treasurer
M. J. Hungerford.....Vice-President
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Eastern Office—232 American Circle Bldg., New York
T. E. DePew, Eastern Manager
Telephone, Columbus 6941

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries.....$4 a year
Single copy, domestic.....25 cents
Single copy, foreign.....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

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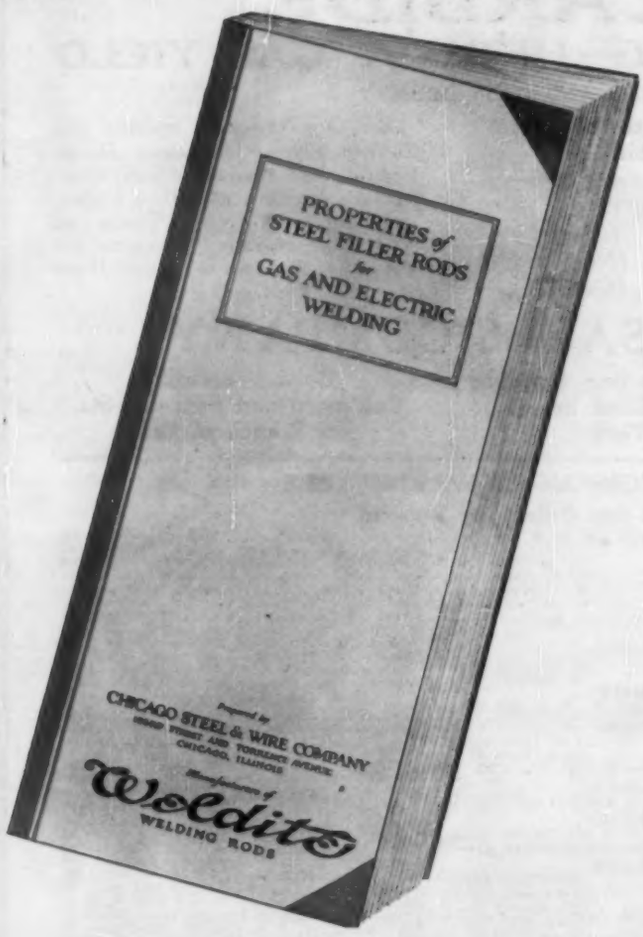
New Welding Rod Facts



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That water under some conditions will ruin a welding rod?

Where gas gets into a welding rod and what its presence means to the welder?

How carbon and manganese affect an electrode?

What the real difference is between gas and electric rod?

Why some welding rod is no better than fence wire and some fence wire makes good welding rod?

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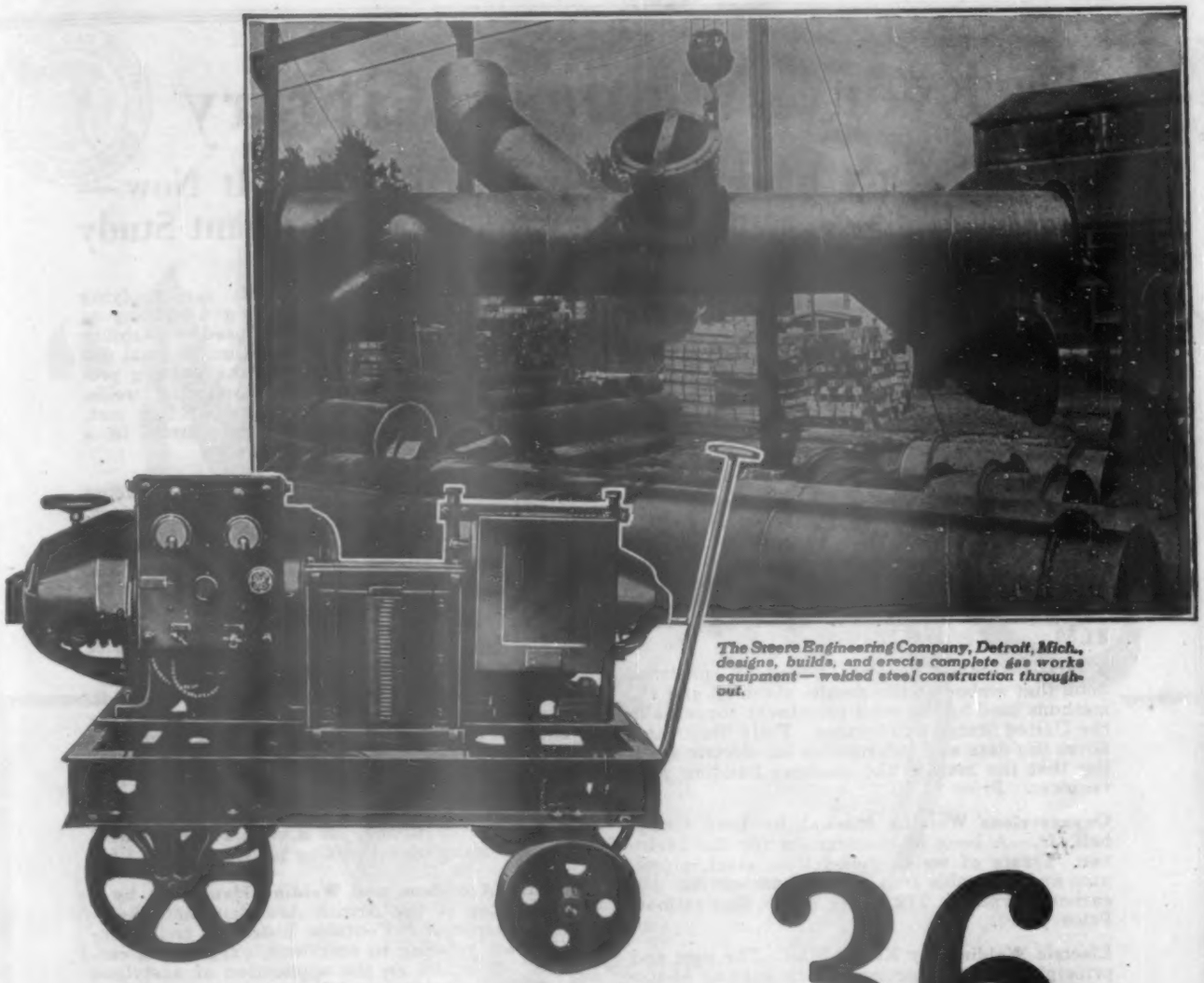

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The Welding Encyclopedia, by Mackenzie and Card, is written for you men who want to know all about welding. It not only solves your welding problems but will also give you a fund of welding knowledge which will increase the efficiency of your shop. Its contents cover in detail all phases of autogenous welding, and in addition many useful charts, tables, rules, regulations, etc. 435 pages, 375 illustrations, bound in black imitation leather. Price $5.00.

Automobile Welding with the Oxyacetylene Flame, by M. Keith Dunham. Explains in a simple manner the apparatus to be used, its care, and how to construct the necessary shop equipment. Tells how to weld all automobile parts in a manner understandable by anyone. 167 pages. 66 illustrations. Pocket size. Price $1.50.

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Electric Arc Welding, by E. Wanamaker and H. K. Pennington. The book covers descriptions of welding systems and their installations, phenomena of the metallic and carbon welding arc, training of operators, methods for applying metal to various types of joints and building-up operations, electrode materials used, weldability of various metals, weld composition, thermal disturbances of parts affected by the welding process, physical properties of completed welds, efficiency of welding equipments, welding cost, etc. 254 pages, 167 illustrations. Size 5 in. x 9 in. Bound in cloth. Price $4.00.

Arc Welding Hand Book—"The Arc Welding Hand Book" by C. J. Holslag, Chief Engineer, Electric Arc Cutting & Welding Co. This book is comprised of 250 pages and numerous illustrations. It is intended to serve as a simple and practical instruction in arc welding, and an attempt has been made to describe the methods, step by step, so that the beginner may understand both the equipment and the process. Price $2.00.

Cutting Iron and Steel With Oxygen, by M. R. Amadeo—A thorough treatise on the use of the cutting torch. Describes apparatus used and methods of operation. Tells influence of oxygen impurities, cutting pressure, effects of preheating cutting oxygen and discusses the heating flame, torch construction, cost of cutting, and cast iron cutting. It is very well illustrated and has many useful cutting tables. Price $1.50.

British Acetylene and Welding Handbook, by a Committee of the British Acetylene and Welding Association. Contains historical and scientific data relating to acetylene, oxygen and carbide. Treatises on the application of acetylene and oxy-acetylene welding and oxy-acetylene cutting. Tests, specifications, regulations, transport conditions, etc., and also the complete reference on acetylene and acetylene welding. Bound in cloth. Price $3.00.

Fundamentals of Welding—Gas, Arc and Thermit, by James W. Owens. Covers all kinds of welding, gas, arc, thermit and resistance. It describes and explains how each is done, and shows which sort is best and cheapest for each purpose, how to calculate stresses and strengths, how to inspect and test a weld, explains the metallurgy of the various welding processes, describes all the kinds of machines and apparatus, and shows advantageous shop layouts and arrangements. Price $10.00.

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The Welding Engineer Publishing Co. September
608 So. Dearborn St., Chicago, Illinois. 1925

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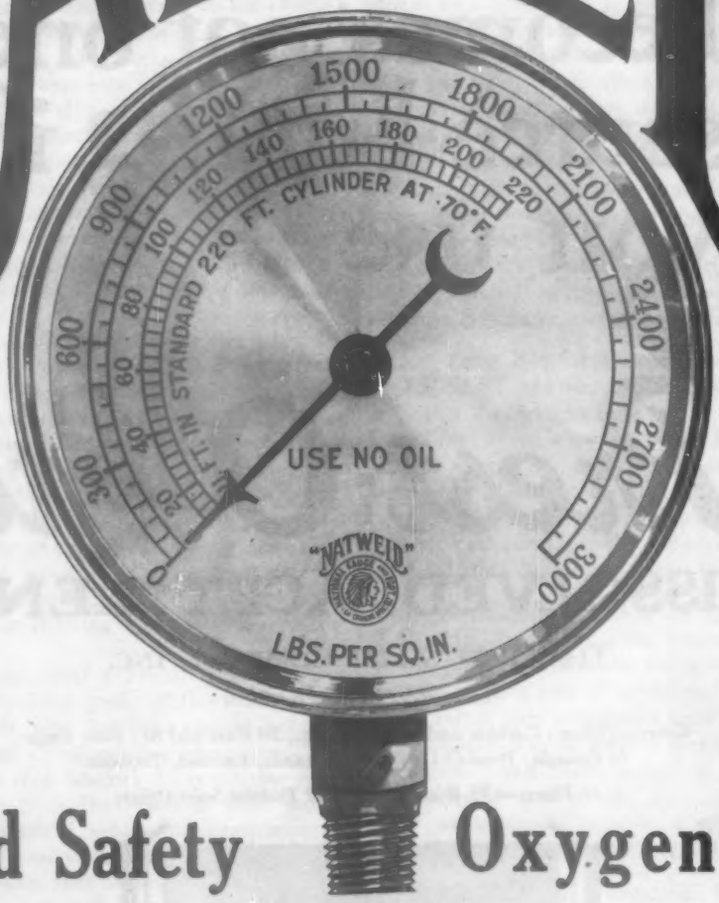

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EDITORIAL

Welding and Health

SOME comment has been heard recently on the subject of the effect of arc welding on the health of the welder. It would seem from these comments that in some plants workmen are actually afraid to attempt the operation on account of the personal injuries which they are led to believe will result from it. Undoubtedly some of this superstition has been caused by confusing effects of the x-rays with the effects of the ultra violet rays. It is true that exposure to x rays is considered somewhat dangerous. In fact, severe effects have been known to follow over-exposure to them. It is also true that there are some kinds of ultra violet radiation which have been used with destructive effect upon bacteria and consequently may be considered as injurious to tissues under certain circumstances. It is for this reason that the delicate structure of the eyes is protected from ultra violet radiation by specially prepared lenses. However, those who have given attention to these effects of ultra violet radiation have overlooked the fact that such radiation does not readily penetrate any subsance except pure quartz. They have also overlooked the fact that a great deal of the ultra violet radiation is highly beneficial to the human system, so beneficial that many physicians today are using a quartz mercury arc lamp to produce ultra violet radiation to which patients are exposed freely.

At a recent convention of physicians in Chicago ane authority on this subject points out that through the stimulation received from this exposure the entire body nutrition is increased, that the heart beats slower and more forcibly because of increased nutrition of the heart muscles following ultra violet treatments. It is doubtful, however, if the welders receive very much benefit from the exposure to the arc because this same authority points out that clothing must be removed for proper treatment.

It is interesting to note, also, that a French eye specialist has just finished a rather extensive study of this whole subject and that he recommends that the eyes should be protected when carrying on all kinds of welding operations. He concludes from his research that welders do not show indications of defective eyesight from the result of their work. He also states the general health of welders does not seem to suffer from the result of their profession. The available statistics show, in two recent years, that sickness and accidents were lower among the welders than in other kinds of work. He goes so far as to suggest that the luminous rays to which the welders are subjected in the course of their work are even beneficial.

Automatics in the Electric Field

PROMINENT among the developments in the electric arc welding field during the past year has been the further perfection of automatic arc welding machinery, employing both the carbon and metallic electrodes. The elimination of variable operating factors through the use of mechanically operated feeding devices is making good production possible on work which was extremely difficult for the average welder to accomplish by hand methods. This need not occasion alarm on the part of any good welder. There certainly is enough hand work to keep him busy, and new fields for his usefulness are rapidly being found. The welder is really certain to benefit by the increased popularity of the process if the automatics become as widely used as their manufacturers seem to hope they will, and show the kind of results that are claimed for them. Automatic arc welding is not new, but much of the equipment which has been made for it during the past twelve months is new in design, and the activity in this field is worth noting now, as an indication of the future possibilities which are open to welding for production work, and, to a somewhat more limited extent, for repair work.

The Torch Is a Good Tool—Respect It

TO THE Service Man the world is at its worst when he is called in to repair a torch, as a last resort. After the amateur has taken it apart, filed it, poked it with a chisel and punch, and ground it, to his heart's content, he can hand it over to the manufacturer's representative and say with perfect truthfulness that it won't work. Good mechanics are inclined to be extremely fussy about the condition of their tools, and, as a contemporary points out, it is small wonder that welders are not held in high esteem by fellow workmen in some shops. Careless treatment of such finely constructed precision tools stamps a man as a poor or indifferent workman. As an example of the service a well built torch can give in proper hands, the story is told of a battleship cut to pieces without it being necessary to change the original tips supplied with the cutting torches for the job. The welder serves himself best when he is considerate of his apparatus.

Does Your Florist Know About Welding?

PERHAPS you have never associated the welding process with the bouquets of roses you have bought for your sweetheart from time to time. If not, you have been overlooking a large bet, according to an article written for a recent issue of a floral paper. One greenhouse has been discovered in which the entire piping system is welded, and the owner is a great enthusiast for the process. And it is surprising how many additional uses have been found, outside of pipe work.

This Should Mean All of Us

IN THE November, 1925, issue of the Revue de la Soudure Autogene we note the following: "Americans are evidently great optimists, full of confidence in the future of their projects; but if they sometimes anticipate their results, they take, nevertheless, a good way to secure them: they study, they experiment. And there is still a great deal of research and experimental work to do. . . . . We ought to follow their work closely." It is a splendid compliment, well deserved by all those who deserve it.

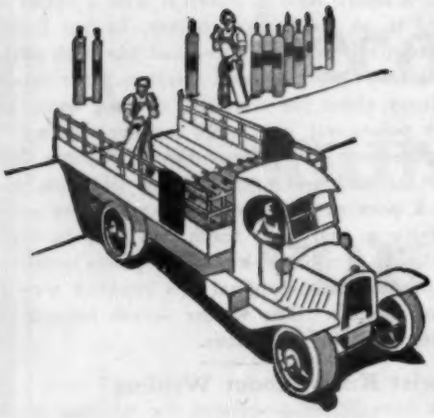
Development in Industrial Standardization

IN A report prepared by C. E. Skinner, chairman, American Engineering Standards Committee, it is pointed out that the closing year has shown important developments in the growth of the industrial standardization movement. One of the most important of these has been the increase of active interest on the part of industrial executives. A conference of first-line executives, held early in the year, organized a committee from their number to serve as an advisory committee to the American Engineering Standards Committee, and these men are now giving time and assistance to the solving of national standardization problems. Formerly, the matter of standardization has been left largely to the technical man, but it is now generally recognized that standardization is a managerial problem of the first rank.

Of special interest to the factory owner and manager is the Directory of Specifications, published in August, 1925, by the Department of Commerce. This compilation lists approximately 27,000 existing specifications covering 6,000 commodities, and it will be found very useful in connection with purchases. The astonishing multiplicity of specifications on the same subject has brought sharply forward the problem of unifying them into consistent groups. Such unification is an industrial and economic problem of the first importance.

What is Linde Service?

Its broad scope is shown by the following typical examples:



1. **Product Service.** Linde engineers discovered how to produce pure oxygen in volume and at low cost. They developed the Linde Type K cylinder which replaced clumsy containers of small capacity. This cylinder is now the accepted standard in the entire industry. Linde engineers also found why valves leaked and built one that wouldn't.

2. **Distribution Service.** Linde executives saw why one big central plant would not insure a supply and how a national chain of plants and warehouses would give each user a dependable and convenient supply with low freight cost. Linde transportation engineers saw the opportunity for truck delivery and planned a trucking service that is always on time.

3. **Process Service.** Linde service is built to serve the smallest user and the largest; with its aid the user solves problems ranging from repairing auto radiators to reclaiming huge castings, from joining small parts of airplanes to welding the joints in hundreds of miles of large diameter pipe, from shaping small plates to dismantling battleships. Linde Process Service is free to every Linde user for the asking.

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Ten Years of Progress

Principles of Welded Processes Well Established Ten Years Ago—Extension and Perfection of Their Use Has Been Rapid

TEN years ago this month, Mr. L. B. Mackenzie, the founder of THE WELDING ENGINEER, and its editor until his death, October 6, 1924, published the first issue of this paper. Throughout the remainder of his life, Mr. Mackenzie devoted most of his energies to the constructive development of THE WELDING ENGINEER, making it an instrument of service to the entire welding industry, always holding his organization up to ideals which should make the work of the paper respected not only in the industrial world but also in the publishing world. The splendid accomplishment of our kind and helpful leader is ever before us as an inspiration. His ideals above are responsible for the feeling which exists that, after ten years, THE WELDING ENGINEER has established a deserved position of leadership in this industry, and is enjoying an upward trend of influence which promises to continue through the coming years.

Although our readers are principally interested in the progress of the welding industry itself, so that we refrain from taking space for detailing the progress made by THE WELDING ENGINEER and THE WELDING ENCYCLOPEDIA, we cannot refrain from publishing the following congratulatory note received from Mr. L. E. Ogden, Vice-President of the Oxweld Acetylene Company. This company needs no introduction. We quote Mr. Ogden's comment on the editorial work:

"It gives me pleasure to offer my congratulations on the Tenth Anniversary of THE WELDING ENGINEER and to express the wish that the next ten years will show as great development in your paper as has been evidenced in the last ten.

"I feel that THE WELDING ENGINEER has served a most useful purpose in the welding industry and that through its energetic editorial force much more can be accomplished for the good of the reader. There is need for new and original material in papers such as your own and I am sure that the industry will appreciate more fully as its experiences grow, through the reading of articles of this character, that much is being offered to them through your paper."

The Oxweld Acetylene Company has been an advertiser in every issue of THE WELDING ENGINEER which has ever been published. From two other companies who had maintained the same close contact with the paper, comments were solicited regarding the developments in the industry during the past decade. Their letters are sufficient to furnish a new inspiration for the future.

Mr. F. B. O'Connor, of the Union Carbide Sales Company, New York, writes:

"The outstanding feature in the development of oxwelding—in fact, of welding as a whole during the past ten years, has been stabilization of the industry and the general acceptance of welding and cutting as a dependable production process, as well as a useful repair process.

"With one or two notable exceptions, especially the cutting of cast iron and the bronze-welding of cast iron pipe, there are few applications in common use today which were not at least tried successfully ten years ago. It is true of course, that the amount of work done in any particular application is greater now than then, but as far as the successful handling of individual welding applications is concerned, it can safely be said that a properly welded pipe joint for instance, made under present conditions, is no better than a properly welded pipe joint made with good equipment and by properly trained welders in 1916.

"There is one outstanding factor, however, which has shown important results. During the last year, the principles of procedure control have been introduced to the users of welding and purchasers of welded products. The effect of this has been that the quality of work reasonably expected under service conditions when these principles are employed has been greatly improved, and to a major degree, the reasons for the old objection to welding that "a weld is as good as the operator" have almost entirely been removed. A properly made weld, made by an operator whose proficiency has been checked, in material known to be of good welding quality, can be depended upon for strength and tightness if the joint is properly designed, the parts are properly prepared for welding and approved welding technique is followed. This dependability can, and should always, be proved by a test of the finished product.

"These things, of course, build toward a stabilized industry and toward the acceptance of welding as a proper production and repair process by engineers and business men."

Mr. A. A. Heller, of the International Oxygen Company, Newark, New Jersey, says:

"The compressed gas industry in the United States, and particularly the manufacture of oxygen, acetylene and hydrogen for the welding and cutting of metals dates from about 1905. In Europe the industry started some years earlier. Commercial plants manufacturing oxygen by the liquid air method developed by Dr. Carl Linde in Germany, and for the manufacture of oxygen and hydrogen by the electrolytic dissociation of water, came into existence in Germany and France around 1900.

"From its beginning the industry in the United States had taken on a practical character, while in Europe considerable experimental work was carried on—with oxygen for increasing the temperature in blast furnaces, with liquid oxygen for blasting, and with hydrogen for ballooning purposes; also in the making of artificial rubies and sapphires, and in the manufacture of nitrogenous products, such as cyanamide.

"The main efforts in the United States in the first years was to develop rapid and economical welding and cutting of steel and other metals by the oxy-acetylene or oxy-hydrogen flame. In this the industry has made rapid progress, especially during the years of the war; today this country stands foremost in the use and applications of oxygen, acetylene, hydrogen and other industrial gases. It is estimated that upwards of two billion cubic feet of oxygen are used in the United States annually.

"The welding and cutting industry in the United States has grown to very large proportions and is now applied not only to repair work and cutting of all metals, but in many lines of production work. The making of welded pipe, steel barrels, steel containers of all kinds, metal furniture, by the torch has become common practice. Also cutting of steel plates to shape, cutting of structural iron, etc., is done by the torch. Welding of gas and oil pipe lines, at times for distances of hundreds of miles, is carried on by the oxy-acetylene torch. In the glass industry oxygen is used for cutting and annealing. In the rubber industry oxygen and acetylene are used for the cleaning of moulds and other purposes. In railroad shops, shipyards and boiler shops a great deal of gas welding and cutting is done in both repair and production work. In foundries and steel works oxygen is used for cutting risers, for opening up furnaces, and for cutting up "frozen" metal. The automobile industry is a very large user of oxygen and acetylene. In the smelting and refining of metals, as well as in the new industry of quartz smelting, oxygen finds large application. Hydrogen is used in the manufacture of tungsten wire for incandescent lamps. As an aid in making repairs of broken machinery there is no better agent than the oxy-

acetylene torch. It may be safely said that there is practically no establishment of any size in the United States where machinery is used or metals handled where the use of oxygen does not effect considerable saving in time and cost.

"Without attempting to enumerate all the applications and uses of oxygen, hydrogen, acetylene, nitrogen, argon and other gases, it is sufficient to note that this industry, established barely some twenty years ago, has grown to such an extent that it employs in the United States nearly five hundred million dollars capital, thousands of welders and cutters, and is represented by about 135 commercial oxygen plants, 65 compressed acetylene plants, and forty to fifty private oxygen and hydrogen plants."

NEW CARBIC GENERATOR

The Carbic Mfg. Co. of Duluth, Minn., have just announced a new X1 Acetylene Generator for welding and cutting. The new model is 39 inches high and its largest diameter is 14 inches. It weighs 45 pounds empty and from 116 to 124 pounds charged. It carries a charge of 1 to 4 No. 20 Carbic Cakes, these cakes consisting of pure carbide compressed to uniform size. The capacity of the Generator is up to 30 cubic feet of acetylene per hour. It is made to operate it with low pressure injector type torch, and will supply acetylene enough for any welding head of a size for welding thickness up to ½ inch, and for all standard cutting nozzles.

The manufacturers state that it is adapted to work of garages, machine shops, railroads, scrap iron firms and many others requiring economical portable equipment for light welding cutting.

R. A. STORM

On January 2, R. A. Storm, manager of the Structural Steel Department of the Morgan Engineering Company, Alliance, Ohio, died rather suddenly of pneumonia.

Mr. Storm was on of the greatest advocates of electric welding that the industry has ever known. He was erector of the first commercial building erected by the arc welding process, a piece of work which was described in the December, 1925, issue of *The Welding Engineer*. It is undoubtedly through his efforts that the structural department of the Morgan Engineering Company have done as much welding as they have, and it is understood that it was his wish to have the process further developed in that department.

His death is a distinct loss to the welding industry, for in his eagerness to develop the use of arc welding he was both unbiased and aggressive, and will be long remembered by the present generation as one who has made a very significant contribution to the progress of this industry.

Mr. Storm was born in Altoona, Pa., forty-three years ago. Prior to 1901 he was connected with the Pittsburgh Steel Car Company in Pittsburgh, and, in 1901 he accepted a position with the Tennessee Coal and Iron Railroad Company of Birmingham, Alabama, as Assistant Superintendent of the Structural Department. While in Birmingham, in the year of 1910, he married Miss Johnnie Randall of that City. In the year of 1916 he accepted a position with The Morgan Engineering Company as Superintendent of the Structural Department. When The Morgan Engineering Company embarked in the rebuilding of locomotives Mr. Storm was made Manager of the Boiler Department, and, afterwards, Manager of the Structural Department. His last address on Electric Welding was given before the American Institute of Steel Construction, at White Sulphur Springs, West Virginia, November 11-14, 1925. For several weeks Mr. Storm had a severe cold which developed into pneumonia, and was only confined to his home two weeks.

SPECTACULAR SAVINGS MADE BY WELDING

As being a typical instance of the large relative savings which can be accomplished in plant repair work where arc welders are used, the Lincoln Electric Company research department at Cleveland has compiled figures covering certain features of such work in cement and other mills.

The report, based on actual and numerous instances of repair work on dust chutes in cement mills, shows that a welded patch costs in tangible expense but one-thirtieth of what the same job would cost by the riveting method.

As being typical of the relative costs found to hold, the research statement gives the following comparison on a repair which requires a 4x4 inch patch in a cement mill:

RIVETED METHOD
2 men required for 2 hours
Operation and Cost

Drill Holes	$1.20
Fit up	.60
Rivet	.60
	$2.40

WELDED METHOD
1 man required for 5 minutes
Operation and Cost

Weld patch	$ .08

On this particular job where the riveting method was used the cost included labor, power and rivets. In the case of the welded job, labor, power and welding wire is included.

It is pointed out that could the total cost be accurately figured on other expenses involved but not a direct part of the particular repair, the comparisons would be even more favorable to electric arc welding as against riveting. When it is necessary to make a repair on a chute, and it is planned to use rivets for the job, the equipment must be shut down in order to allow a man to get inside of the chute to do the riveting.

MORAL:—GIVE THE NEWSPAPERS GOOD SERVICE

"Oxy-Bill" Hamlett, of Silver City, New Mexico, evidently turned out a good welding job for his local newspaper, the Enterprise, as witness the following from a recent issue:

"Right in the middle of a rush job which was in progress in the Enterprise office this week—snap—and off went a little chunk of metal about the size of buckshot and a whole machine went promptly out of commission. With a customer waiting and depending on a promise to deliver his printing the office faced the necessity of sending to Denver for a new part and waiting a week to get it.

"Individual and concerted profanity was indulged in but in spite of the danger of setting fire to the plant, nothing was accomplished. The part was still broken and the machine was still out of commission and Denver was still five days away.

"Just then familiarity with the advertising columns of the Enterprise came to our rescue. Why not try "Oxy" Bill Hamlett, the welding shark? A drowning man grasps at straws but we grasped at "Oxy" Bill and he did not fail us. In thirty minutes the part was back and the machine was performing as though nothing had ever happened. The customer got his printing as per schedule and aside from the few busy minutes thrust upon the recording angel the damage was practically nothing.

"The world do move. To one who has spent most of his life convinced that a broken casting was not mendable and has lived in fear of some essential part "busting" at some critical moment, this new art of welding seems like a great achievement of science. And it is. Thousands of dollars in time and money have been saved by it right here in Silver City.

"Mr. Hamlett, who served for a number of years as life saver for the Chino Copper company, that is, where broken parts of machinery were concerned, claims that he can weld anything but a broken heart. That exception don't worry the Enterprise Publishing company none."

Arc Welding in the Building Industry

Laboratory Tests of Welded and Riveted Joints Side by Side Point to a Wider Field of Usefulness for Welding on Structural Steel

AT THE November meeting of the American Welding Society, Chicago Section, Mr. A. G. Bissell, of the Westinghouse Electric & Manufacturing Co., presented an excellent paper on the subject of Arc Welding in the building industry. The main theme of this paper was a description of tests made under the direction of Mr. Bissell to determine the strength and endurance of arc welded structures under various service conditions. Before going into the subject of tests the speaker described, and illustrated, a number of important

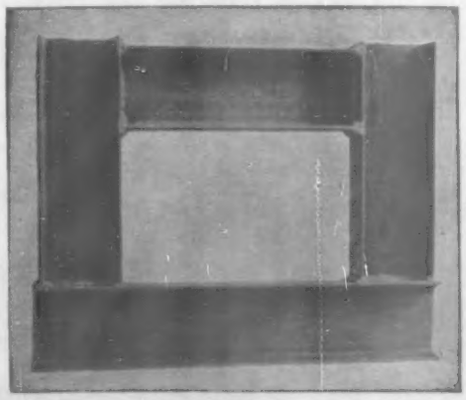


Fig.1—Arc Welded Structural Steel Test Piece Made of 6 in. 14¾ No. I Beam.

welding jobs on heavy structures such as locomotive frames, rudder posts and huge tanks. He then showed the nature of the changes produced in steel by the arc deposit and explained how the quality of the work in heavy jobs could be improved by the use of the "rigid string" method of welding. The tests, which were then described by Mr. Bissell, were performed because he had not been able to find a record of tests by vibration or impact in structural fabrication.

Therefore, in order that information might be obtained that

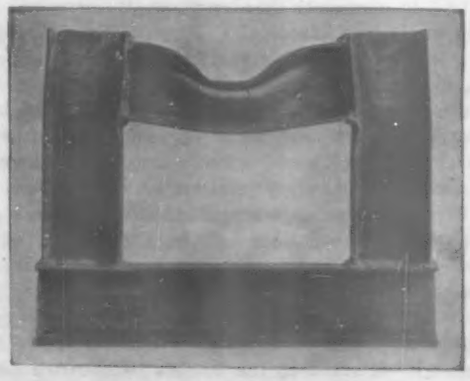


Fig. 2—Test Piece Shown in Figure 1 After Withstanding Crushing Pressure of 740 tons Without Damage to Weld.

would throw some light on the resistance that structural steel fabricated by arc-welding would offer to vibratory and impact strains, several test pieces were made and subjected to static, fatigue and impact loads. In these tests, a joint was used that would approach that which would be used in actual practice. Clip angles, reinforcing plates, and other extra items ordinarily used in riveting were eliminated. The joints tested were made by joining 6"x12.25# I beams to other members.

Static

A test piece for use in determining the resistance of arc-welded joints to a static load was made by uniting four 6"x 12.25# I beams, as shown in Figure 1. In this test piece, the 18" horizontal crossmember was attached to the flanges of the

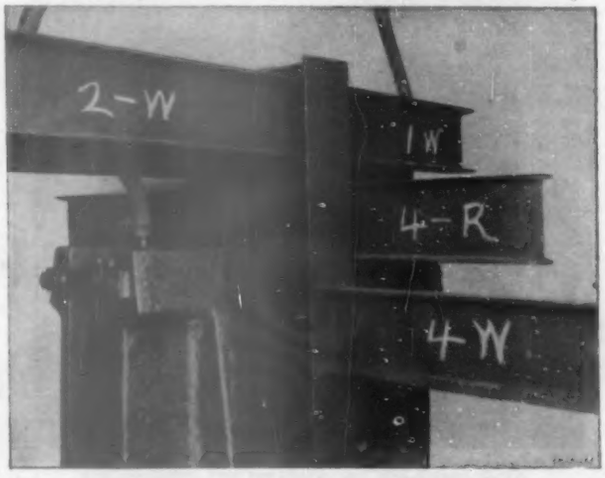


Fig. 3—Arc welds In Vibration Test Piece.

vertical members by fillet welds around the contacting parts as shown in the photograph. To test this structure it was placed in a hydraulic press and pressure applied to the center of the horizontal member through the end of a piece of 3" shafting.

At pressure of 40 tons, the horizontal and vertical members began to deform, the pressure falling to 35 tons. This pressure was applied until the horizontal member was deformed as shown in Fig. 2. The extent of the crushing was limited

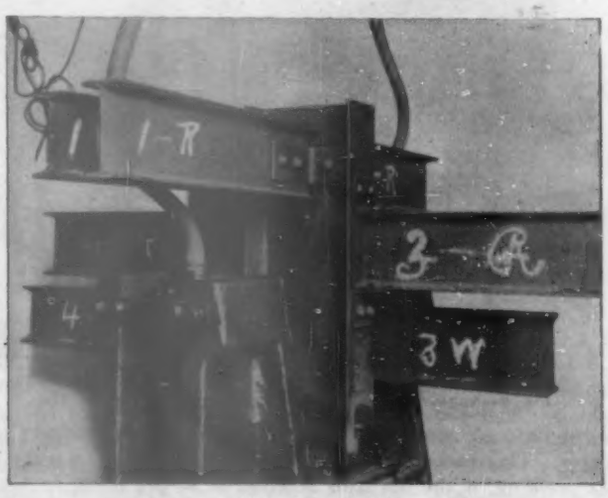


Fig. 4—Riveted Joints in Vibration Test Piece.

by the base I beam which deformed, causing the test piece to slip out of the press. An examination of all the joints in this

test piece, after the test, failed to show any evidence of failure in the welded joints. This is evidence that a joint of this nature will hold even though the connected members may be badly deformed.

Fatigue

To determine the effect of vibration on arc-welded joints in structural steel, a test piece was constructed of two 10"x25# I beams to one of which were arc welded four 6"x12.25# I beams 24" long. To the other, four 6"x12.25# I beams 24" long were riveted.

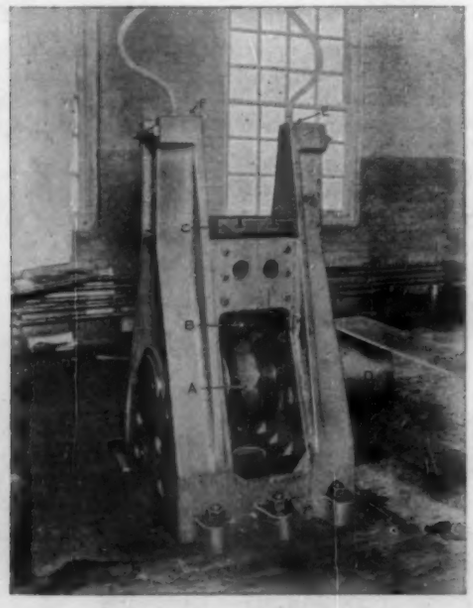


Fig. 5—Vibratory Test Machine.

As illustrated in Figure 3, the 6" I beams are attached to the web and flanges of the 10" I beam by a fillet weld. The only preparatory work performed in making these joints consisted of cleaning the scale from the parts to be welded. These welds were made by an average welder working under the same conditions that might be expected in actual practice. Each joint required approximately 0.6 pounds of metal and

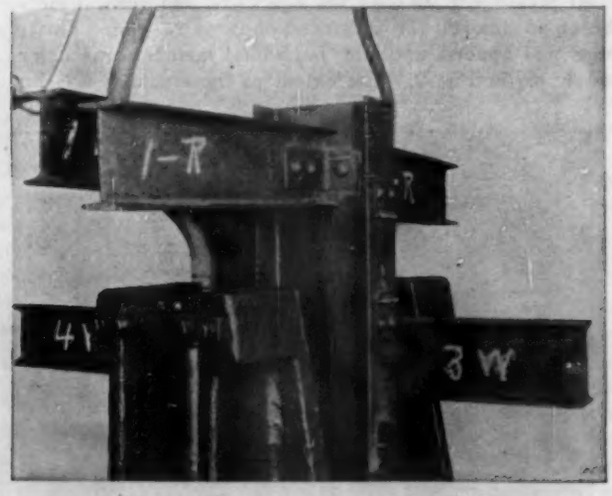


Fig. 6—Appearance of Riveted Test Pieces After First Test.

from 12 to 15 minutes to weld, using $\frac{1}{4}$" wire at 150-160 amperes. This makes the cost of this joint around 35 cents for the welding, if the operator receives $1.00 per hour.

A riveted joint uniting the members in a similar manner is shown in Fig. 4. Two 6"x12.25# I beams 24" long were riveted to the web of the 10"x25# I beams. A standard beam connection was used as specified on page 246 of the Carnegie Steel Company's Pocket Companion, Twentieth Edition, 1919. This shows that beam connections for 7", 6", 5" I beams are made using 2 Ls 6"x4"x3$\frac{1}{8}$"x0'-3". Two $\frac{3}{4}$" rivets through the web of the I beam attach the 6" leg of each of the angle clips to the I beam. One $\frac{3}{4}$" rivet through the 4" leg of each clip attaches it to the web of the other member. In this test piece, in order that the 6" I beam might be attached to the web of a 10" I beam, it was necessary to use 6"x3$\frac{1}{2}$"x$\frac{3}{8}$" angle clips and space the two $\frac{3}{4}$" rivets 4$\frac{1}{2}$" instead of 5$\frac{1}{2}$". Otherwise the joint was standard.

In order to have a 6" I beam attached to the flange of the 10" I beam by riveting, a joint as described was calculated. Two 4"x4"x$\frac{1}{4}$"x0'-3" Ls. were riveted to the flanges of the two members by $\frac{5}{8}$" rivets, two rivets being used through each leg of the clip angles. In both of these riveted test pieces, the rivets were driven hot by hand.

Both the riveted and welded test piece were mounted on a one-inch plate 14"x22" by uniting the 10" beam and this plate by a fillet weld. This combined test piece was securely bolted by four 1" bolts to the bed plate of a vibratory test machine and subjected to vibratory or vertical movements of $\frac{1}{16}$" at the rate of 1760 complete cycles per minute.

This vibratory testing machine is shown in Figure 5. It consists of a pulley (A) having 8 flat surfaces equally spaced around the external face, mounted in extra heavy bearings and driven at 220 rpm. through pulley (D), by a motor. Just

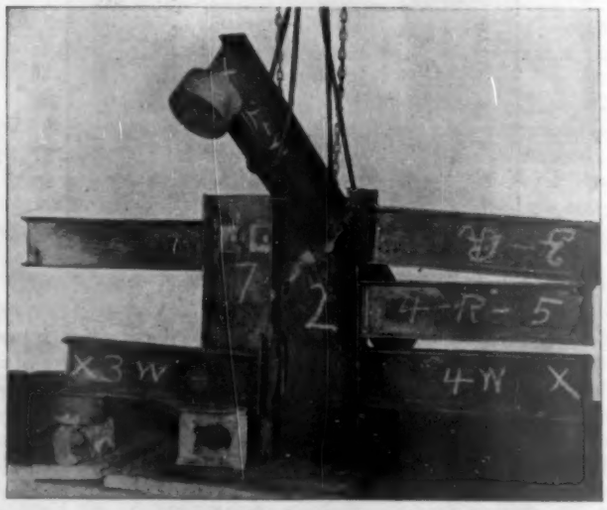


Fig. 7—Arc Welds Held—Steel Beams Fail in Test.

above (A) is a smooth-faced pulley (B) attached by heavy bearings to the bed plate (C). This pulley (B) and bedplate (C) are free to move in a vertical plane. As pulley (A) is rotated, its flat faces cause pulley (B), and therefore the bedplate (C), to rise and fall $\frac{1}{16}$". To make this bedplate return immediately after rising, an air pressure piston is installed at each side (F & E) which keeps a constant down pressure on the bedplate and insures contact between pulleys A and B. Pulley D is operated at a speed of 220 rpm, which gives the bedplate 1760 vibrations per minute.

In order to identify the members of these test pieces, they were marked as follows:

1R and 2R—Riveted to opposite sides of web of 10" I beam.

3R and 4R—Riveted to the flanges of the 10" I beam.

1W and 2W—Arc welded to the opposite sides of web of 10" I beam.

3W and 4W—Arc welded to the flanges of the 10" I beam.

The first test period lasted 18 hours and 20 minutes. At 24 minutes of vibration the lower clip angle on specimen 3R failed. At 42 minutes, the lower clip angle in 4R failed. At one hour, the upper clip angle on 3R failed, removing the member. When the remaining clip angle failed at two hours and four minutes, 4R was removed. The nature of the failures can be seen in Fig. 6. It should be noted that failure was due to fatigue of the metal in the clip angles.

Within an hour after the vibration was started, the clip

angles on 1R and 2R began to show a movement that increased until, at 3 hours and 45 minutes, the rivets had been loosened sufficiently to allow a movement of ¼ inch at the free end of both 1R and 2R. By 4 hours and 15 minutes, this movement had increased to ½ inch. By this time the vibration was exerting very little effect as these members were so loose that they received but few of the shocks simply bouncing up on about every fifth or sixth vibration. The result of this movement was to swedge the rivet down to a reduced cross section and enlarge the rivet holes.

During this time the arc-welded test piece, attached to the same base, was receiving the same vibrations. At all times, during the 18 hours and 20 minutes, the arc-welded members gave a clear ring when struck with a hammer, showing that no failure had started in or about the welds in the first period of the test. It might be mentioned here that all four of the holding-down bolts through the base of the test piece failed from fatigue showing to some extent the severity of the test.

As it appeared that it would require considerable time to produce a failure in any of the arc-welded members, it was decided to attach a load to the end of each arc-welded member and thus accelerate the test. For this reason 25-pound sections of 6″ shafting were arc-welded to the lower flange at

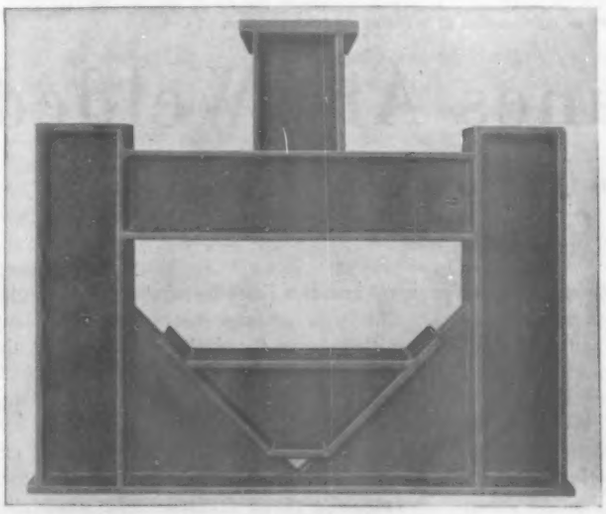


Fig. 8—Specimen for Shock Test.

the extreme end of each of the arc-welded members and vibration continued for 22 hours and 10 minutes.

At the end of an hour, on the second period, the web surrounding the section to which members 1W and 2W were attached failed. It will be noticed in Fig. 7 that these members are still securely attached to each other through a section of the web. After 20 hours and 40 minutes or a total of 39 hours and 5 minutes, the flange and web of the 10″ I beam to which 3W was attached gave away as shown in Fig. 7. This failure was probably due to the web of the 10″ I beam cracking down from the top. Had this crack not occurred, 3W would probably have held indefinitely, as at the end of this period, 4W was intact and there was no evidence of failure in the weld in surrounding metal. After 3W was removed, the vibration was continued for an additional hour but owing to the damaged condition of the 10″ I beams, both being badly cracked, the test was discontinued.

Shock

After having found that the arc-welded joints in structural steel were capable of withstanding as much static and vibratory loading as the structural members themselves, the only remaining data to be obtained was the effect of shock in these joints. The test piece, shown in Figure 8, to be subjected to a sudden shock was made by arc welding two 6″x12.25# I beams, 24″ long, to a ½″x3″ base plate. These vertical I beams were joined near the tops by a similar I beam of the same length. This I beam was attached to the flanges of the vertical I beam by a fillet weld having approximately ⅜″ contact on each member. To receive the blow, an 8″ piece of a 6″ I beam capped with a piece of 1″ plate, was attached to the center of the upper flange of the horizontal member. To prevent the vertical members from collapsing and the base from buckling, the bracing shown in

Fig. 9—Shock Test Specimen and 2000 Pound Steam Hammer Used in Test.

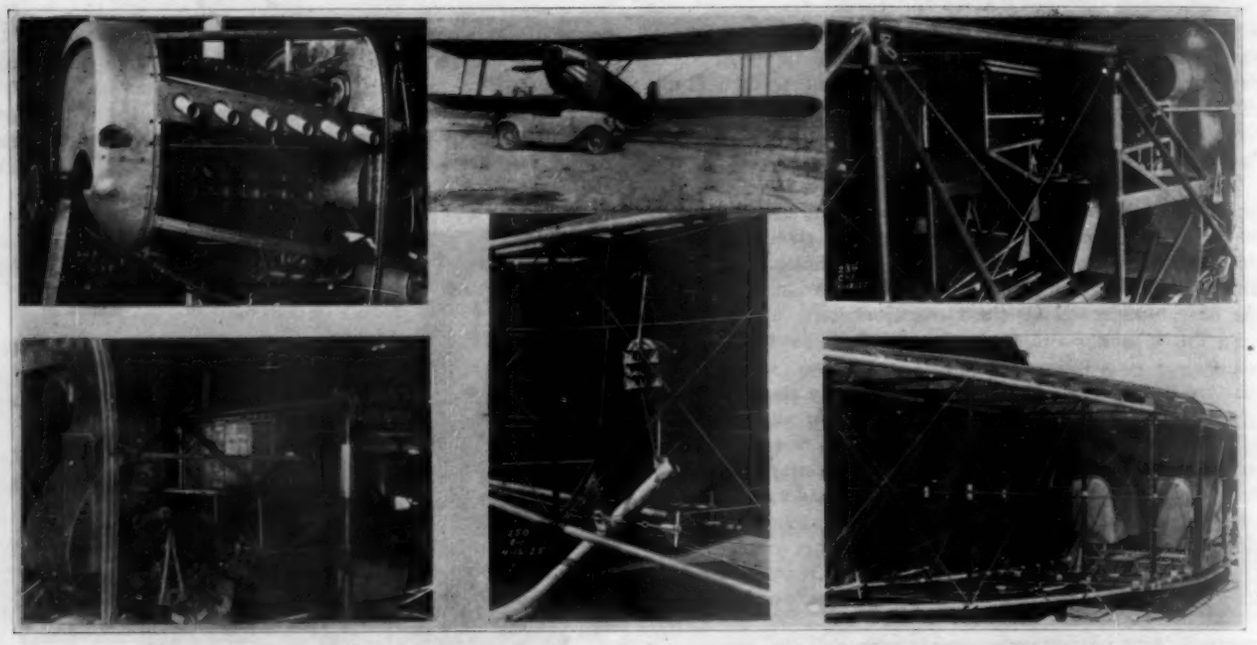
Fig. 8 was installed. Since the horizontal member was attached quite near the tops of the vertical members, caps were welded to the top ends of the vertical I beams to prevent them from splitting through the web.

This test piece was placed on a solid foundation consisting of a heavy plate supported by the anvil and two 12″12″ timbers under the 2000-ton steam hammer shown in Fig. 9.

Fig. 10—Shock Specimen After Test. All Arc Welds Intact.

First a light blow was delivered upon the plate on the extended I beam to settle the set up. The effect of this blow was not evident so a blow of approximately ⅓ the capacity of the hammer or about 700 tons was delivered on the 1″ plate that capped the extended I beam. The impact of this blow drove this short I beam into the horizontal member which in collapsing drew in the vertical I beams, bending them at the top of the cross braces as shown in Fig. 10. There is no doubt but that a very severe shock strain was

(*Continued on page* 39)



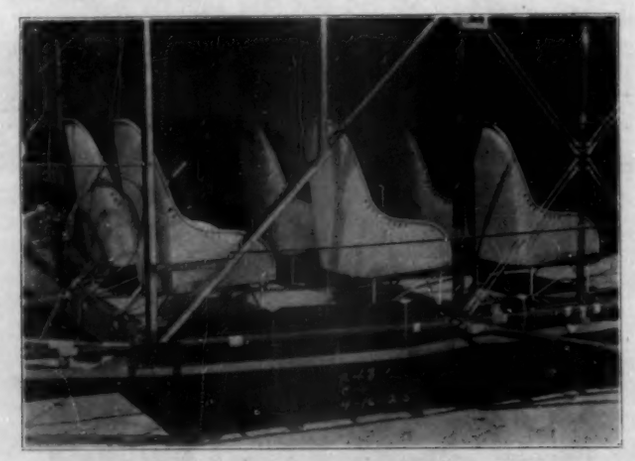
Top Center—View of C-1. Other Photos Show Various Application of Welding in Construction of C-1.

World's Greatest Planes Are Welded

Service Showings Which Make Light of Questions Recently Raised Regarding the Advisability of Welded Construction for Flying Craft

WITHOUT any fanfare of trumpets or waving of flags, Donald W. Douglas, the aeronautical genius who presides over the romantic destinies of the Douglas Aircraft Corporation, of Santa Monica, California, has within recent weeks put into service new types of Douglas ships that may well change the entire destiny of the nation.

Mr. Douglas will be remembered as the ex-naval officer



Interior of Cabin. Aluminum Seats Supported on Welded Steel Members.

who built the famous and successful round-the-world planes for the United States Army, which were very largely of welded construction. The round-the-would flight demonstrated conclusively that welded metal fuselage was the logical construction for long distance flying and so this is the rule in the Douglas planes now being built. Purox apparatus is used in the construction.

Aeroplane design is passing through the same metamorphosis as that which occurred in battleship design when metal was substituted for wood and the fuselage of the new Douglas planes is all-metal. This new metal construction has many advantages and one of them was forcefully illustrated at the recent international air races when the pilot of one of these new Douglas battle planes struck a telegraph pole in rising from the ground, ripping off one side of the running gear and the struts of the plane. The crowd gasped with horror, expecting to see the plane go to pieces at once and the aviators dashed to death. Instead, the plane seemed to be unaffected by the collision, making a successful flight and a safe landing, which shows how much welded metal construction means to the safety of flying.

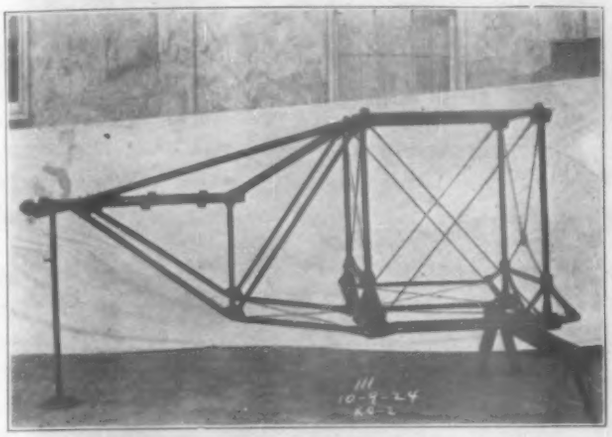
How powerful these new Douglas planes are is indicated by the specifications they fulfill. For example, the Type C-1 transport biplane has a cruising radius of 4,500 miles without refueling. It can carry a ton of explosives, without stopping, from any suitable hopping-off place on the Atlantic coast to Paris or any other West European capital; or, with one stop in the Aleutian Islands of Alaska, it can carry the same load 6,000 miles from Los Angeles to Tokio, flying all the time at the rate of 125 miles an hour. The wing spread is 60 feet, the length 35 feet 6 inches. The motors are 400 horsepower Liberties and the landing speed is 46 miles an hour. These planes climb 15,900 feet with a full load in forty-five minutes. They weigh 3,800 pounds empty and are capable of carrying seven soldiers besides the pilot.

Mr. Douglas is also building what he calls the "Type O-2 Observation Plane" for the Air Service. A development of this airplane has been designed for the United States Post Office Department. This ship, like the C-1, has welded chrome molydenum steel framework; flies at the rate of 145 miles an hour; will carry 1,000 pounds of mail over the high peaks of the Sierras, and will climb, fully loaded, to a height of 17,500 feet in forty minutes.

The welding together of these great ships of the air represents the forging of another link in the chain of America's

mechanical progress and adds greatly to the prestige and military prowess of the nation.

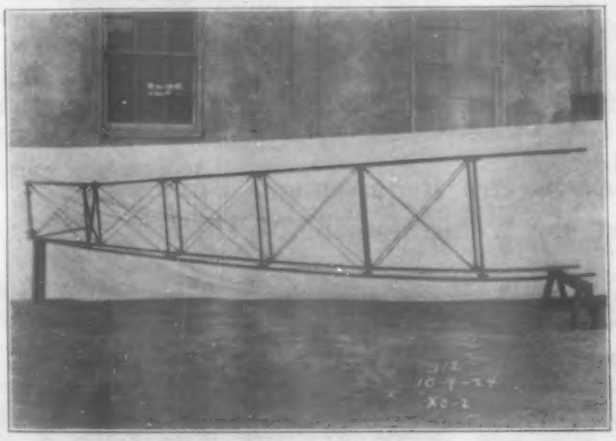
Whether it be the strength and safety of a gas pipeline or that of an aeroplane that is being considered, there is a modern mechanical axiom that is always worth remembering—"'Tis well to weld."



Welded Frame of Engine Fuselage on Type 0-2 Machine.

That no anxiety need be felt on the score of "fatigue" when airplane welding is well done, is apparent from the following statment made by Mr. Douglas in commenting upon a recent article on this subject in one of the engineering magazines:

"In the DT torpedo planes we built with welded steel engine and mid-fuselage sections, the rear fuselage section of wood was pinned to the steel mid-section. The first wear apparent was in the pins pounding the attachment ear holes through the sheet until finally failure resulted. No welds fatigued at the time. The ears were designed with supposedly ample allowance for shock.



All Joints of Rear Fuselage of 0-2 Are Welded.

"Welding, when the detail is correct, has a big strength margin to take care of fatigue, and it is easier and lighter and cheaper to get a high enough margin in welded joints than in pinned joints.

"No welds in the world cruisers 'fatigued.' The fuselage and tail surfaces, landing gear and many parts of these cruisers were welded steel."

The International Oxygen Co., Newark, N. J., is said to have closed arrangements with the Soviet Government, Russia, for the construction of nine welding plants in industrial centers of that country. The company will carry out the project in co-operation with the Russian Metal Syndicate, a new organization to be formed under the name of the Russian-American Gas Co.

J. W. OWENS LEAVES NAVY

Mr. James W. Owens, the navy's authority on welding, will become affiliated with the Newport News Shipbuilding and Dry Dock Company on January 1, as their director of welding. Mr. Owens became associated with the Welding Committee of the Emergency Fleet Corporation in April, 1918, and in September, 1918, received a special appointment at the Norfolk yard as Welding Aide.

J. W. Owens.

He organized the first welding shop in the navy, trained a large number of welders, has conducted many fundamental researches in welding and is the author of a book, "Fundamentals of Welding."

At the Newport News shipyard Mr. Owens will have responsible charge of all welding development. Mr. Homer L. Ferguson, the president of the company, has decided to extend the use of welding to all classes of work undertaken by his company and it is believed that the welding industry can look forward to some epoch-making welding applications in the near future. Mr. Owens was one of the organizers of the American Welding Society, is a former vice-president of the society and a member of the American Interstate Association of Electrical Engineers and the Hampton Roads Engineers Club. He has lectured on welding before these bodies and is a frequent contributor to the technical press.

When Mr. Owens left the service of the navy he wrote a note to his superiors offering to hold himself in readiness to meet the needs of the naval establishment in any emergencies that may arise. Admiral Cole makes grateful acknowledgment of this offer in a note to Mr. Owens, at the same time expressing appreciation for the loyal and efficient service which he has so far rendered to the navy. This incident called forth a splendid editorial comment in a recent issue of the Portsmouth Star.

THE ANDERSON WELDING STAND

The Anderson Welding Stand is a device manufactured by the Faribault Machine Shop and Foundry, Faribault, Minn. This table is an assembly of a variety of fixtures for holding parts in place for welding. The table itself is made of strongly ribbed and accurately machined surface plate having a series of cored openings of various sizes and shapes to allow hubs of gears and other irregular pieces to lie flat on the surface.

The plate measures 13x24 inches and has a machined V the entire length with additional V blocks for building up when welding shafts, or other parts to be welded in a line. At the center is provided an opening to allow the flame to pass through. Interchangeable leveling plates are used when offset broken parts are to be set up for welding.

The leveling blocks can be adjusted to a very fine adjustment by the use of a screw and clamp, and it entirely does away with hunting for a shim of the right thickness which cannot be found. Shafts of different sizes are used so parts with holes, such as gears, pulleys and other castings may be revolved to the best position for the welder. The shaft may be pulled out or receded to accommodate the work. Angle or adjustable bracket is used for welding teeth in bevel or miter gears and may be set at any degree.

A babbit receiver in the table is used to save the babbit when melting out boxes. A three point base is used and will stand properly on the floor; stand may be revolved or fastened by hand screw. A V shaped casting is used for holding small castings and sometimes takes the place of an extra man.

At Over One Hundred Pounds Pressure, Here is the Tank Which Was Expected to Fail at Twenty-Five Pounds Pressure.

Welded Storage Tanks Are Safe

A Sample Tank Tested Far Beyond Any Service Requirements Finally Gives Way Through the Original Sheet, the Welds Showing No Distress

NOT long ago a letter was received from a manufacturer of Storage Tanks stating that he had been very well satisfied with the application of welding in the construction of his tanks, but that he needed some evidence to convince architects and engineers to whom his products were sold for such construction was absolutely safe.

At about the same time a letter was received from Mr. Gunnell Moore of the Boardman Co., Oklahoma City, Oklahoma, stating that the latter company had recently conducted a very interesting test in connection with underground storage tanks under supervision of the National Board of Fire Underwriters. The Boardman Co. are nationally known as manufacturers of all manner of tanks, smoke stacks, condensers, road machinery, bridges and heavy sheet metal work and a number of their welded products have been described in previous issues of *The Welding Engineer* as examples of the possibilities which exist for turning out superior work through the use of welding. Therefore, a representative was sent to visit the Boardman plant and secure additional information regarding the test mentioned in Mr. Moore's letter.

"When I called at the plant," says the report, "I was certainly astonished at the success of the test which they made on welded tanks for underground gasoline storage. Certainly after noticing this test no man could doubt the value of welding when it is performed by a capable operator, and with responsible supervision. It is evident that they desired to learn for their own information just how much abuse a tank of this kind could stand.

"The tank is made of 14 gauge galvanized iron. It is 36 inches in diameter with a capacity of 275 gallons. The seams are acetylene welded and the tanks are reinforced on the inside at each end to support weight of the earth. These supports are only tacked in place, using a small tack weld about every 6 inches.

"The first step in the test was to subject the tank to a

(*Continued on page* 40)

Rebuilding Oil Field Tanks

Big Savings Accomplished by Prairie Pipe Line Company, Cutting Up Old Tanks, and Welding Pieces Together to Make New Ones

By D. W. Moore

OIL field storage tanks, especially the smaller sizes, have long been a bone of contention in the reclamation program of many oil companies. Usually, a considerable amount of labor and material had to be expended in rebuilding them and much of this material included new bottoms and other equipment.

The advent of electric arc welding has changed the old method into one with many economies. Old scrap material, such as is commonly used as junk, can be employed and a much neater job of rebuilding or repairing can be done at a greatly reduced cost.

When it is considered that the ordinary steel tank carries several thousand rivets, each of which must be punched to fit and constitutes a possible source of leakage as well as deterioration, the use of a continuous steel surface as practiced in arc welding, can better be understood. This story concerns the use of arc welding in rebuilding oil field tanks as practiced by the Prairie Pipe Line Co. and was obtained from N. E. Wagner, superintendent of welding. We quote Mr. Wagner thus:

Arc welding, we have found, will best accomplish the purpose of rebuilding small tanks and repairing the bottoms on large tanks instead of riveting. In the repairing of old bottoms on tanks ranging from 3,000 to 35,000 barrel capacity, all seams and rivet holes are welded up when the rivets are pulled out, instead of cutting down the shell of the tank and re-riveting the old bottom, laying a new bottom as was formerly practiced before arc welding was employed.

Patch Bolting Is a Slow Process

Another method of repairing old tank bottoms where the iron was still good but many rivets had been eaten off, was to use the patch bolt. First, the hole from which the rivet came was tapped with a 7/16 or 1/2-inch tap, whichever the case may be, to take care of the rivet hole size. Then the threaded patch bolt (a bolt with cone shaped head with a square on center of head for wrench to be applied) was screwed into the threaded hole, thus drawing the two sheets together. After caulking carefully, the job was completed. In cases where many rivets were eaten off, this was a very slow process and not as strong a job as arc welding, nor was it as economical as arc welding.

The Prairie Pipe Line Company has welded or made repairs on several 35,000-barrel tanks, also a number of smaller sizes. On some of the tanks we found the rivets and caulking seams eaten so badly that it was necessary to make a complete welding job of the entire bottom, welding all seams and rivet holes. Before proceeding with this work, the iron was inspected to assure that the arc welding job would pay. We have completed several successful repair jobs of this kind, using in many cases iron from the junk pile. All jobs were tested with water pressure under bottoms before allowing the tank to be placed back in service. Much to our surprise we have found only one or two small leaks in all the arc welding work we have done on tank bottoms.

120 Barrel Steel Tank All Welded. Holes At Top Caused by the Removal of Rivets to Make Way for Welding.

Old Material Used for New Tanks

During the past year we completed fifteen arc welded tanks ranging in size from 120 barrels to 480 barrels. These tanks were made from iron taken from a 35,000-barrel tank that had been rebuilt so many times that the rivet holes were extra large and the iron would have required reshearing and repunching to be used in construction of large tanks again. The officials of the company decided to make use of this iron in making small tanks.

Consequently, the iron was taken to our shops, the bottoms and shells laid out, trimmed with an acetylene cutting torch and rolled to the proper circle for various size tanks, which as stated above ranged from 120 to 480 barrels capacity each. Each tank, after being trimmed and rolled, was then shipped to its destination and built on the job where it was to be

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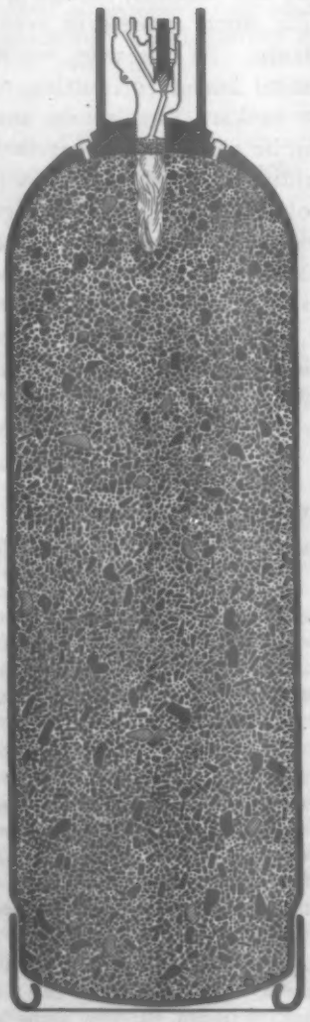

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placed in service. To many, this may seem like extra expense as they would wonder why the tank could not be built at the shop and ship arc welded, but due to the particular work for which these tanks were intended and the many different settings which varied at each station, we decided it was best to build the tanks at the station.

You will understand that all the shell iron from the cut down 35,000-barrel tanks was used in making the fifteen smaller tanks. This iron ranged in thickness from 7/16 inch to 3/16 inch, the lighter iron being used in building the smaller tanks.

How Welded Tanks Are Assembled

In constructing these tanks, we laid as many sheets as were required to make the bottom. The circle cut

Arc Welded Seam Joining Shell to Bottom of 480 Barrel Tank.

on the bottom was made from ½ to ¾ inches larger than the line where the shell sheets were to be placed. The bottom ring sheets were sheared on both sides and one end. One side or edge of the bottom ring sheets were placed on a circular line on the bottom, first tacked about one foot spaces and after the bottom ring was set up and tacked, we continued to place other rings. All sheets in rings above the bottom rings were sheared on one side and one end. In placing each ring, the sheets were placed inside the ring below with about 1½ inches overlap. This allowed us to burn holes with the acetylene cutting torch and insert bolts so as to draw the sheets together and make each sheet or ring fit perfectly.

After the sheets were all raised, bolted and tacked, we proceeded with continuous welding, welding on both sides of the bottom ring where it connected to the tank bottom. All other seams were welded on the outside only. At points where bolts were used to draw the iron together, we replaced the bolts with rivets after the iron was tacked into place. Very few bolts or rivets were required in constructing these tanks, as only those required were to fit the iron to place.

Three Pinholes in Fifteen Tanks

In all the fifteen tanks constructed from the old iron in the 35,000-barrel tank, we only had two or three small pinhole leaks when they were tested. These leaks were on the vertical seams where it seemed most difficult for welders to handle the metal.

It has been impractical to attempt to rebuild large tanks by this method, though we have used arc welding with much success in repairing the bottoms of large tanks. In this work we fill the old rivet holes with metal instead of cutting them off as in case of smaller tanks. The largest tank in our experience that can be conveniently handled in rebuilding by the arc welding method is the 500-barrel size. It is because of the novelty and newness of the arc welding method in tank construction and repair work that we have had no chance to prepare comparative figures on this and the old method, but we do know that the saving in time, labor and material tells us that the arc welding method far outclasses any other in economies effected. The use of old scrap material in place of new material alone makes the difference.

DENVER CONCERN HOLDS HOUSE-WARMING

Compressed Gas Corporation and Affiliated Companies Entertain Visitors

Among the important American industries whose business has grown up during the past ten years from little out-of-the-way shops to concerns of nationwide magnitude is The Compressed Gas Corporation, which with the Purox Company and its other affiliated companies on December 30, gave an old-fashioned house-warming at its new Denver plant and general office building.

Throughout the day and during the evening, visitors representing the operating, executive, and purchasing departments of Denver and Colorado railroads, manufacturers, mechanical establishments, and jobbers thronged the new building, and were shown how oxygen is made from water and from air and how it is applied not only in the welding and cutting of metals, by Purox apparatus, but also in industrial chemistry.

The Compressed Gas Corporation was organized in 1916, at which time it was operating but one plant for the production of oxygen and hydrogen. It now owns and operates oxygen and hydrogen plants in Denver, Salt Lake City, Seattle, Oakland and Los Angeles, a large welding and cutting apparatus factory at Los Angeles, and acetylene plants at Los Angeles and Oakland. In addition to sales offices at these points, direct factory-branch offices for the distribution of welding and cutting apparatus and supplies are maintained at New York, Cleveland, Detroit, and New Orleans. Mr. W. E. Porter, of Denver, is president; Mr. Claude K. Boettcher is Vice President; Mr. C. O. Epperson is General Manager; Mr. Clark G. Mitchell and Mr. Harry C. James are members of the Board of Directors; and Mr. P. D. Gleason is local manager.

Procedure Control in Welding*

There Are Six Factors to Consider in Planning Every Piece of Welding—The Good Supervisor Will Consider All of Them

L. E. Ogden†

THE industrial history of this country has been fundamentally the same as that of Europe since the so-called Industrial Revolution, which began about 1770. The chief difference is that we have experienced an industrial development in a much shorter period of time, passing with striking rapidity through all the stages leading up to the modern factory system.

Due to keen competition for the business of an enormously increasing population we now lead the world in labor-saving machinery. Quantity production of high quality goods is necessary to the life of our manufacturing plants. They are continually facing the problem of increasing their production at a lower unit cost, and this is made possible largely through greater efficiency within their own organization. These problems have developed the science of production engineering, and today in every modern plant production engineers are working out ways and means of lowering costs, and increasing production so that the sales departments can successfully meet competition and market the product.

Every Process Controlled and Supervised

Such manufacturers have consequently installed "procedure control" systems (whether or not they are called by that name) whereby every step of production is controlled and supervised to secure the highest resultant efficiency. To this end the abolition of waste motion, waste material and loss in time is necessary for the reduction of costs.

In this search for the one best way to manufacture their products a great many manufacturers have recognized the benefits to be derived by oxy-acetylene welding. It is unnecessary to amplify here the reasons for changing to this modern method of metal fabrication, as each application would require a special discussion, and the general argument is well known to you. Suffice it to say that manufacturers now using the oxy-acetylene process have a clear vision of the enormous possibilities it offers.

However, not all of them by any means are using the oxy-acetylene process to its fullest economic extent. Nor do all manufacturers realize that welding is not a hit-or-miss operation, but is an orderly procedure involving consideration of certain well-defined steps. Some have recognized this fact, to the lasting benefit of their own organizations and to the betterment of their product. Since they have installed efficiency control systems in other departments, they would not allow the welding operations to shift in an "every-man-for-himself" manner.

Good Welding Requires Organization

In well organized plants procedure control of welding is of exactly the same importance as in any other unit operation of manufacturing department. Of course, competent welders are essential for good welding, the same as skilled mechanics are necessary for the tool room, but they are only *one* of the vital factors in insuring successful work. Welders are not responsible for the location of their equipment, the material to be fabricated efficient placement of jigs, clamps, wrenches, and gas supply. I do not hesitate to say that good welding comes only from an organization, which as a whole, sincerely believes in welding. The production engineer, chemist and even the management itself, superintendent and master mechanic must all believe in the soundness of this production method which plays a major part in the scheme of things which are fabricated by welding.

In the majority of cases where experiences and data on all these details are lacking, the management looks to the manufacturers of welding gases and equipment for assistance. And this is quite logical. We in the industry have, or should have a wealth of information on practically all phases of production welding. This information is of great value to the manufacturer, and he wants to secure it. The *dissemination* of the information we have is worth even more to us than it is to the customer who receives it. No matter how vast our supply of data, it is worthless unless passed on to those who can use it.

Recognizing this existing need for knowledge of methods whereby welding or cutting efficiency may be increased, the affiliated companies of the Union Carbide and Carbon Corporation interested primarily in the advancement of the oxy-acetylene process have formulated a set of fundamental principles called "procedure control." This group or principles is so designed that it can be readily adapted to any application of oxwelding, although it is of greatest aid for applications demanding repetitive operations. When a request for such definite information is received a statement of correct procedure in the light of present knowledge is prepared and given to the customer.

Procedure Controls Are for Supervisors

Procedure controls are designed not for the welder but for those in charge of the work,—the manager and superintendent of the plant. That is to say, for those directing the production. If the subdivisions of the outline are properly filled with the required information and the procedure then closely followed to the logical conclusion, high efficiency welding will result.

The specifications of a procedure control are grouped under the following heads:

(A) A Check on the Welders
(B) Selection and Inspection of the Material
(C) Design and Layout of the Welded Joint
(D) Preparation of the Piece for Welding
(E) Welding Technique (including Organization)
(F) Inspection of Welding, and Test of Completed Joint.

Let me amplify each subdivision in turn.

A—A Check on the Welders

The employment department and the works manager should satisfy themselves regarding the welder's skill and experience in the kind of work he will be called upon to perform. Welders should be given and required to pass bending and tensile strength tests indicating the quality of work they are able to do. Many companies put their welders through a special training course before this final test permtis them to "go on the job." Should the inspector have any doubts later as to the quality of the welds being made, he should again require the welder to make up a new set of test pieces. Periodic tests should also be given each welder to determine his current competency.

B—Selection and Inspection of the Material

In production work specifications of the material to be welded should be stated in detail, including the chemical

*Paper presented at the Annual Meeting of the International Acetylene Association, Chicago, November 18, 1925.

†Vice-President, Oxweld Acetylene Co.

analysis required, its cleanliness and its weldability. The type of welding rod, flux (if needed), gases, pressures, welding and cutting equipment, size welding head to be used, as well as accessory materials such as jigs and clamps should be specified or designed, and all duly inspected before acceptance.

C—Design and Layout of the Welded Joint

Specifications should be given for beveling the ends or edges of the welded pieces, whether single vee, double vee or at a certain angle to within a given distance of the bottom. It should be specified that when beveling is done with the blowpipe the edges must be properly cleaned, and all oxide removed by file, grinder, or hammer and chisel. Specifications should also be given for the spacing of the material depending on the kind and thickness of the metal, the method of welding (whether flat or vertical) and how fixed in position (with clamps or tack-welds). Details concerning the weld metal, such as fusion, penetration, physical characteristics and dimensions of the weld should be included under this heading.

D—Preparation of the Piece for Welding

Here should be stipulated in step by step outline the alignment, cleaning and spacing of the edges (or ends) of the pieces, clamping and tacking.

E—Welding Technique

This may be subdivided into Organization, and Actual Welding.

"Organization" here includes the personnel directly connected with the welding. For instance, in pipe welding this includes the "bull gang," (which lines and blocks the pipe) tacking gang, welding gang, and laying gang who make the tie-in welds, and put slack in the line by crotching, making the overbends, and sagbends.

Under "Actual Welding" should be included all specifications for welding due to the peculiarities of the work in hand. Again selecting pipe welding as an instance, this should include peculiarities in construction due to the kind of country passed over, specifications regarding rolling welds and position welds, how to make the longitudinal and girth seams and whether they are to ripple or flat welds. The desired amount of reheating should also be noted.

F—Inspection of Welding and Test of Completed Joint

Under "Inspection" should be listed the qualifications of the inspector, his authority (which is usually independent of the welding foreman) and his duties. He should watch the welders for correct practices, see that the dimensions of the weld conform to specifications. He is also responsible for inspection of welding rod. Any rewelding necessary should be carefully watched. He should also see that each weld is identified by the welder's number. (Inspection of apparatus and maintaining its condition are duties of the welding foreman, not the inspector.)

Under "Testing" should be specified the types of tests to be applied and supervised for acceptance or rejection by the inspector. In pipe line welding this should state the length of the section to be tested, the pressures to be applied, the medium used, and specifications for making repairs to any leaky joints which might appear.

Applicable To All Welding Jobs

The outline for Procedure Control just given is, as I have said, exceedingly flexible, and will readily lend itself to compiling a guide for any welding application. The peculiarities of each individual problem should be first studied, and the Procedure Control written with these problems in mind. As an example of how such a Procedure Control functions, I call to mind a problem confronting a company in Portland, Oregon, which secured the contract to lay a 7-mile water line of 30-in. and 24-in. steel pipe. Because of prohibitive freight rates on pipe from the East, it was decided to have flat boiler plate shipped via the Panama Canal and then to roll it, and weld the longitudinal and circumferential seams after it arrived. In other words, fabricate the pipe by oxwelding.

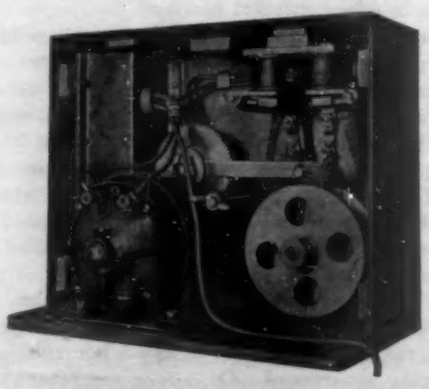
Not being familiar with the correct way to handle the job most efficiently, this company asked aid from the oxygen supplier, the Linde Air Products Company. A Procedure Control for doing this work was carefully prepared from data at New York, and a Linde service engineer then sent to Portland to supervise the job, which included special training of the welders as well as following out the Procedure Control detail, practically to the letter. The line was laid to the entire satisfaction of everyone concerned. The Procedure Control made it possible to eliminate a great deal of lost motion, and insured a highly satisfactory job completed well within the time limit of the contract.

With the knowledge of a considerable number of such instances to fortify me, I do not hesitate to say that manufacturing plants or field organizations doing production welding will find it highly profitable to secure or develop a procedure control for the supervision and advancement of their production methods. As mentionad at the very outset, large organizations in quantity production have well developed departments whose sole duty is to study designs and methods leading to the best way to manufacture the product, step by step. Such organization may be easily sold the idea of proceduce control in welding. It is language they undertsand. They welcome co-operation with their suppliers of welding gases and equipment in developing procedure control of the welding operations in their plant.

Smaller organizations doing production welding should also listen favorably to a proposal that some member of the supervisory staff should give a portion of his time to a serious consideration to the best way to control the welding operation. To such smaller organizations the members of the International Acetylene Association can be of greatest assistance, laying before them the accumulated information of many years' study and experience in the development of the industry.

WESTINGHOUSE FEATURES AUTOMATICS

In the current number of the annual review of "Westinghouse Achievements" published by the Westinghouse Electric and Mfg., Co., the most featured subject in electric welding is an automatic arc welding head which has been developed and placed on the market. This device takes the place of the arc welder's hand and feeds the welding wire to the arc continuously from a reel. It will maintain a fifteen volt arc continuously, which is from



New Westinghouse Automatic Arc Welding Head.

5 to 10 volts lower than the best hand welders can maintain. This assures better quality of deposited metal. Due to the method employed of obtaining the feed of the wire, a constant speed motor is used of sufficient power to feed wire in sizes from $\frac{1}{8}$ inch to $\frac{3}{8}$ inch in diameter. Furthermore, no change of gears or adjustment of the mechanism is required when the size of the wire is changed because the feeding mechanism and control automatically maintains the proper rate of feed determined entirely by the arc voltage.

This machine will not "freeze" the electrode to work under any conditions due to the quickness with which the arc is struck and the power developed by the constant speed non-reversing motor.

Arc Welding Fans and Blowers

Improved Product Has Been the Result of Adopting Welding in the Assembly of Blower Equipment

By J. B. Flock*

IN very few modern industries has such radical changes been made from cast iron and steel riveted construction to electric arc welding as has been shown by the progress of electric arc welding in the blower industry. The Robinson Ventilating Company of Pittsburgh, Pa., with the use of Lincoln Stable-Arc Welders, have developed their product to the point where their blower wheels, fan casings and other parts of the equipment, are fabricated without the use of any rivets. Under present market conditions, it is necessary for an industrial enterprise to reduce costs by more efficient methods and at the same time improve the quality of their equipment. In the blower industry this is being done with welded construction.

Fig. 1—Development of Blower Industry from Cast Iron to Welded Steel Construction.

Figure 1 shows the trend of the blower industry during the last ten or fifteen years. In the past, blower and fan casings were made with the use of cast iron. Needless to say, a blower of this type now looks as obsolete as a 1900 automobile.

Due to the low cost of steel and its adaptability to fabrication, the cast iron blower casings were eliminated and riveted steel construction substituted. It has been found that electric arc welded construction has still further reduced costs and improved the quality of fans. This is especially true in the fabrication of blower wheels. With riveted construction, it is necessary to lay out blades through templates, punch the ends for rivet holes, and die crimp the edges, assemble and rivet. With the welding process it is only necessary to cut off the flat steel the proper length, dish the blades for the proper pitch by running them through rolls, and weld them to the fan rims. (Figure 2.) By riveting, it was almost impossible to get the rims of the larger blower wheels, 4 ft. in diameter and larger, perfectly true due to the variation in the bending over the ends of the blades; with welded construction the blades are all of one length and assembled and tacked to the wheel rim; after the tacking is completed the blades are welded their entire length on both sides, making a job which is strong, perfect in alignment, and a type of construction which offers less friction to the passage of air between the blades, due to the absence of rivet heads.

The benefits to the user are—fans of higher mechanical efficiency, stronger construction, and a blower which will not loosen up and get out of balance as is the case with riveted blowers when they have been in service a number of years. The joints also of such a fan will be air tight, thus eliminating air losses.

Blower wheels when fabricated by the electric arc welding process represent a shop saving of over 25 per cent. This saving is due to the fact that with the electric arc welding process the material has to pass through a fewer number of operations than with the riveted construction. In riveting, as the blades are laid out, punched, bent, and formed, it is necessary to rivet to the wheel rims. The riveting process requires the work of three men. With the welding process, one man can weld up a wheel, thus eliminating the work of two other men.

In blast furnace work, the welded wheel has resulted in large savings to the user. The gas which is drawn off from the blast furnace with fans, is full

*Welding Department, Lincoln Electric Co., Pittsburgh.

of dust and dirt. This dust with a riveted fan gradually wears down and cuts off the rivet heads allowing the fan blades to loosen up and unbalance the fan. With the welded fan, there are no projections to receive the cutting action of the dust and fan blades will

Fig. 2—Blades Welded to Fan Rim.

wear down more evenly. This is also true in cement mills where considerable trouble has been experienced in the past due to dust getting under rivet heads, cutting them out and loosening them up.

Figure No. 3 shows a blower directly connected to

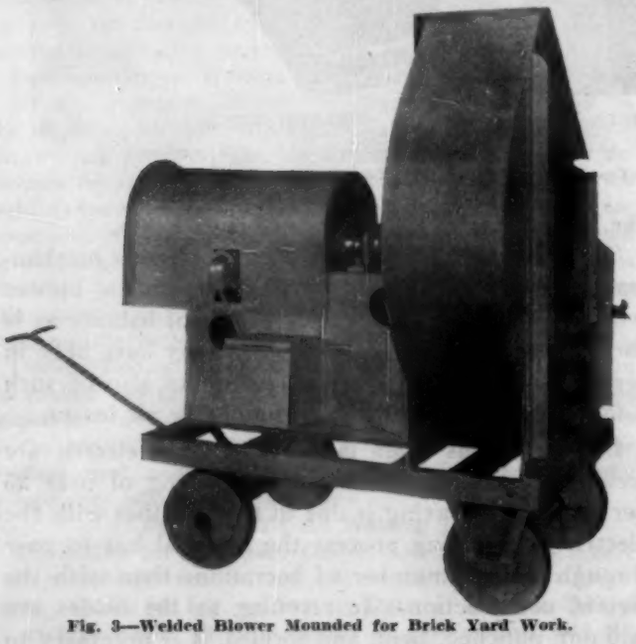


Fig. 3—Welded Blower Mounded for Brick Yard Work.

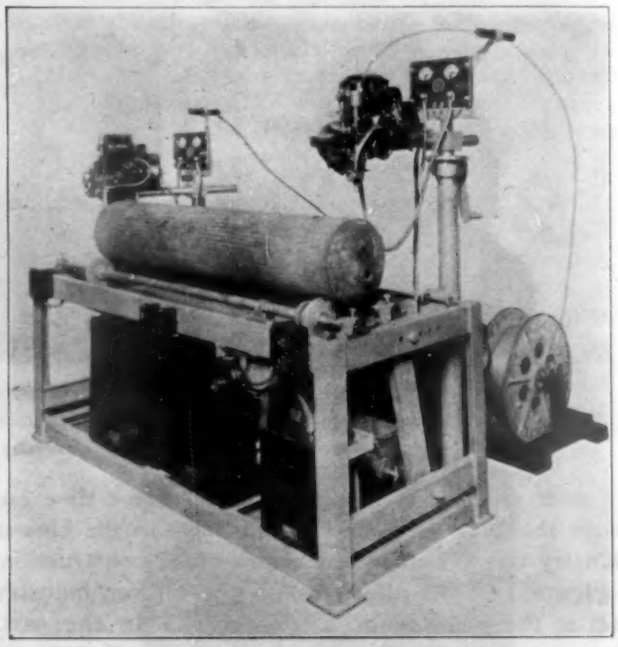
a motor which is used for brick yard work to draw off the exhaust gases of the kiln. This entire outfit is completely welded. The fan casing, the blower wheel, the truck, also the truck wheels, are of modern arc welded construction. With the hard usage experienced by a fan of this type around a brick yard, the welded construction will keep the fan tight and in alignment, as there are absolutely no rivets to work loose. The fan shown in the sketch is also used to blow fresh air in the kilns after the bricks are baked; thus cooling off the kilns more quickly and saving about a day on each firing of the kiln.

The Robinson Ventilating Company have been building a fan with the electric arc welding process for a number of years and have standardized on the manufacture of fans of this type. In this way, they have been able to improve their product, increase the capacity of their plant with less capital investment, make shorter deliveries, and, at the same time, eliminate considerable maintenance expense usually experienced in the maintenance of air compressors, air tools, air hose, and punching equipment.

Welded blowers and fans have long passed the experimental stage and the fact is so recognized by live up-to-date factory executives and engineers.

1925 BRINGS NEW MODELS TO LINE OF G-E AUTOMATICS

Commenting on the progress made in the field of arc welding during the year 1925, a recent article in the General Electric Review says:



One of the Latest of the G-E Automatic Line of Welding Machine. Detail of Test Pieces.

"The line of self-excited, brush-shifting welding machines of the single-operator type, which was first brought out in 1924 in the form of a 200-amp. continuous-rated machine, was completed by the addition of 150- and 300-amp. machines of the same type.

"The construction and application of automatic welding machines for the commercial production of tanks, range boilers, etc., was continued and a variety of mechanisms adapted to particular classes of work were constructed. In each case, the equipment comprises the welding head, control panel, push buttons, meters and the necessary propulsion machinery."

The Earle Gear & Machine Company, Philadelphia, Pa., have sold and transferred all designs, patterns, patents, and good will covering Earle Centrifugal Pumps to the Aldrich Pump Co., Allentown, Pa. This transfer will in no way conflict with the regular business of the Earle Gear & Machine Co., in manufacturing cut gears, moveable bridge operating machinery, cold metal saws, and special machinery.

Oxygen and Acetylene Piping*

How to Make a Survey of the Plant so That the Oxygen and Acetylene Pipe Lines May Be Installed at Least Cost and to the Best Advantage

By W. A. Slack†

THE making of a Correct Survey in a shop, factory, industrial plant or railroad shop before proceeding with the actual installation of pipe lines is fully as important as the installing of the pipe lines themselves. Altogether too many pipe lines have been put in without due consideration having been given to the physical limitation of the plants where they are installed, and as a result, much dissatisfaction is expressed by their owners because they were led to expect results not possible from their installations.

The engineer in charge of an installation must, of necessity, be familiar with the regulations, which have been laid down by the National Board of Fire Underwriters before he can make an intelligent survey. Without this information at his command he is sure working in the dark to a large extent and is almost sure to overlook things of minor and even major importance in making his plans.

Good Planning Means Fewer Changes in Layout

When beginning, the engineer is to all purposes in the same position that a civil engineer would be, were he sent out to map a piece of unsurveyed territory, unless the engineer is fortunate enough to have a plant assigned to him, correct accurate plans of which are kept up by the engineering department of the concern operating it. Of course, if the plant is a new one, the work is even more simple, but the engineer should be most careful to check back the major details of plant layout in any event and make his plans accordingly or he is almost sure to find himself forced to make changes in his layout, which may affect the operation of his installation more than is desirable.

However, so as to have a definite situation to discuss, let us assume the engineer is sent to a large plant, which has been in operation a dozen or more years and, in which gas welding and cutting operations were started only a matter of six or eight years ago. Since that time two new departments have been added in wings, which have been added onto the main building, and welding and cutting operations are being carried on in both of them. This would not be an unusual situation nor would it present conditions more difficult than might be expected in any fairly good sized industrial or railroad installation.

Welding Should Be Separate Department

Of course, the ideal arrangement for the engineer to suggest to the plant owners is that they centralize their welding and cutting operations in one place and plan their installation accordingly, but this is not desirable always and so we are going to start off with saying that this cannot be done in this instance.

With a plat of the plant before him, which he has either made or had furnished to him, the engineer must next locate the welding and cutting operations definitely. This can be done quite easily with the aid of the plant authorities and its planning department. Where these operations cannot be centralized it will be found, usually, that gas welding and cutting are used in production work, and it is here that the suggestions from the planning department will be found most valuable.

Provide Adequate Pipe Lines

The work having been located the next step is to find out the volume, how many torches will be used, and the probable amount of gases that will be required. Right here is the place for a word of caution, too much care cannot be taken in estimating the amount of gases that will be needed, so as to insure an ample supply at all times. One of the greatest causes for complaints in our experience has been that pipe lines are too small to take care of requirements. The engineer who made the initial survey is not always altogether to blame, because too often the information given him is inaccurate and the demand for economy in first costs is so urgent that he permits smaller pipe to be used, than is wise. We believe, and our experience carries out our beliefs, that if the engineer insists on plenty of pipe capacity and backs his insistence with good and sufficient reasons he will overcome very easily any opposition he may meet, because of initial expense. One or two dimension larger pipe will make a big difference in the carrying capacity of the pipe and add but comparatively little to the installation cost.

We do not believe in the use of quarter-inch drops of any great length, ⅜ in. is small enough, and we believe half-inch pipe is even better. We do not care to go into the discussion of pipe sizes further at this time, because pipe sizes for every installation will have to be decided on its individual merits.

Location of Generator and Manifolds

Having located the welding and cutting operations and estimated the gas requirements, the next step for the engineer is to locate the generator and manifold house or houses. Do not think that we mean to infer that the manifold and generator may be located in the same room, when we say generator and manifold house, but where a new building must be erected or an old one utilized, suitable fire wall partitions will comply with every requirement and effect an economy in building, by housing both generator and manifold in the same building, but that is optional.

The building site having been selected, the engineer must make most careful check of its surroundings so that he will be sure to have sewer connections available for drainage from his sludge pit, an approach, which is not likely to be blockaded by traffic of any kind and facilities for handling carbide cans and oxygen cylinders with the least possible effort and cost.

In planning a new building or remodeling an old one, the location of entrances, heating, lighting and ventilation, would be laid out to meet insurance regulations. Carbide storage should be provided and so located that it will be dry at all times and separate from either the manifold or generator rooms. A place should also be provided where oxygen cylinders can be kept dry and out of the storms.

Pipe Lines Should Drain Back

The work having been located, and the generator and manifold rooms having been arranged for, the engineer must now lay out his pipe lines. Of course, if he is fortunate enough to have a condition where his supply lines are short and there is nothing to prevent his running them direct to the work, his job will be comparatively easy. About all he will have to watch is the locating of his generator or manifold, the installation of proper plashbacks, safety check valves, line control valves, and drainage, so both gases will be supplied, dry and pure to the drops in sufficient quantity to meet the demand for it. It is always better to lay out pipe lines so they will drain back to the source where possible, because the gases will not then carry much surplus moisture with them very far.

But such ideal conditions are not found very often. Driveways, industrial tracks and switch tracks must be crossed or gone under; traveling cranes, derricks and monorail systems

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*Paper read before International Acetylene Association, Chicago, November, 1925.

†President, Torchweld Equipment Co.

must be passed and other industrial impediments in the shape of pneumatic hoists, line shafting and driving gear avoided, if a successful and satisfactory installation is made.

More than likely, it will be necessary for the pipe lines to be carried underground for some considerable distance in order to avoid one or more of these difficulties, and then draining pits must be provided and precautions taken to prevent freezing. This last applies, of course, in all installations, but freezing pipes when underground are a greater hardship than when above ground and easily accessible, and wherever the pipes drop down or slope away from the source suitable drainage outlets should be installed.

Preserve All Survey Data

When the engineer started on his journey he not only secured a plat of the ground he had to cover, but also an engineer's field book and, as he worked from place to place, he entered into his field book for permanent record complete notes so that when his survey was made he could sit at his desk or drawing board and layout in detail every drop, every bend, every valve, every drain, every check, and flashback, and the length and size of all piping, including supply lines, laterals and drops in their proper localities, so that any mechanic, able to read a blue print, could make a complete installation, without further assistance.

With the completion of his plan the engineer's work is done, except for the supervision of the mechanics of installation. If his job has been well planned, all joints will be welded, except where the use of fittings prevent it, because welded joints stay tight and screwed joints do not, so the welded joint is better and, happily, cheaper, too. Screwed joints may be made tight with white lead on the acetylene line, but litharge and glycerine should be used on the oxygen lines; never white lead. The pipe lines will be as nearly straight as possible, all bends will be made on as big a radius as practicable, sharp turns avoided wherever possible and reductions in pipe sizes made with careful consideration of the requirements of the work.

Welded Lines Require Wrought Iron Pipe

The use of welded joints will necessitate the use of wrought iron pipe in the pipe lines. Wrought iron is better than steel, because it will resist rust and corrosion much better. The pipe should be cleaned as thoroughly as possible. This oxygen pipe should be heated to a good heat and afterwards washed out with a very strong hot solution of caustic soda or tetrachloride, so as to be sure that all grease and oil are removed from the pipe before it is joined together. Oil will not interfere in the acetylene line, so long as the pipe is clean otherwise. After the pipe has been cleaned it should be cut and welded together in sections.

The sections are then slung into place and welded together. The ends are capped, valves and safety checks put in place and the line tested. Compressed air is ideal for this purpose wherever it is available. Possible leaks are located and made tight. The lines blown out, the gases turned into their respective lines, the air exhausted, the torches attached and the work begins.

Soon, much sooner than the uninitiated can comprehend, the pipe lines properly installed by following correct plans made as the result of a thorough survey, are proving themselves a great convenience and becoming a source of profit.

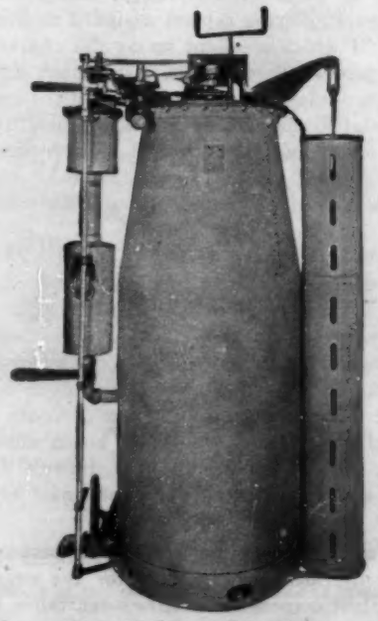
BASTIAN & BLESSING ANNOUNCE NEW GENERATORS

Announcement has just been made of the Rego line of acetylene generators for welding and cutting which are being manufactured by the Bastin-Blessing Co., of Chicago, Ill. The stationary model is made in 100 and 300 pounds carbide capacity, giving normal gas delivery of 100 and 300 cubic feet per hour, or 450 and 1,350 cubic feet per charge. The generator shell is made of heavy galvanized sheet steel above the water line and black sheet steel below, with all welded seams. A weight operates a motor-driven revolving feed plate, from which the carbide is scraped into the water by the flexible feed ring. The rate at which the carbide is fed is controlled by the gas pressure on the diaphragm operating a direct brake

Rego Portable Generator.

on a variable speed generator. The generators are equipped with direct automatic blow-off valves of extra large capacity.

The portable models are made in 30-pound and 60-pound carbide capacities with approximately 140 and 280 cubic feet of acetylene carbide per charge at the normal rate of 30 and 60 cubic feet per hour. The carbide feed is an automatic valve operated by a vibrator which is controlled by the pressure. The carbide hopper is a single casting on which is



Rego Stationary Generator.

mounted the entire feed and feed locking mechanism. The water and gas generating chamber is of all welded steel construction protected from corrosion by galvanizing. The low center of gravity makes outsetting very difficult. Each generator is equipped with two extra large blow-off valves. The trucks are of all welded construction and are designed to bring the center of gravity low.

A. M. ROSS ACCEPTS WICKWIRE-SPENCER APPOINTMENT

Albert M. Ross, formerly of the International General Electric Company, has joined the selling force of the Wickwire Spencer Steel Company as a consultant engineer on welding problems, and will have charge of the sale of all types of welding wires and rods.

Safety Department Approves Welding

Description of a Test Which Secured for a Detroit Contractor the Permission to Weld a New Addition to an Old Building

REFERENCE has previously been made in *The Welding Engineer* to the welding done in the Peoples Outfitting Building in Detroit, Mich. This work was done by the Titus Welding Co, of Detroit, under the direction of Clyde Centers, Mgr.

Albert Kahn was the architect of the new twelve story addition, Mr. Mattie having personal supervision. Detroit Structural Steel Company were the erectors.

103 I Beams from 10 in. to 24 in. were welded to the

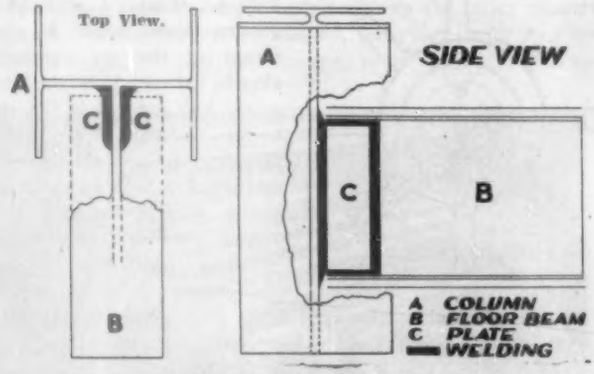
Peoples Outfitting Building, Detroit, Showing Where New Section Was Welded to Old Building.

old building to support the floor and roof. The bulk of these beams being 18 in. 269¼ hours were required to complete the job, two-thirds of which represent actual welding time, the other one-third was spent waiting for moving and erecting necessary scaffolding. The latter was done by the Steel Company, as well as the lining up of the beams. The welding equipment consisted of a 200 ampere Lincoln Direct Current Welder with 300 feet of cable. 705 pounds of 3/16 mild steel electrodes were used.

This method of welding instead of rivets to join the I beams to the H columns of the old building, offered quite a saving, when it was considered that in order to rivet this job, the entire brick wall of the old building would have to be torn out, tying up one-third of the store's floor space and, covering the rest with dirt. For the welding job, only a small portion of the concrete and brick was removed to allow for the welding, business being carried on as usual in the store.

This job was started on Friday, March 13th, 1925, in the worst kind of weather, wind, snow and rain. Giving one of the iron workers' point of view, it was the most miserable job, due to the fact that it was such a narrow building and a rush job.

Before the work was allowed to proceed it was necessary to get the approval of the department of building and safety engineering. This approval was obtained by submitting a sample of the joint which the commissioners subjected to test. Sketches show the nature of the samples submitted and the following report from the



Sketch of Test Piece.

laboratory describes procedure followed in testing the joints.

"Two (2) 8 in. 'I' Beam sections were welded to opposite sides of the web of an 8 in. 'H' Column 1 ft. 6 in. long. Each connection was made by means of two 4 in. x ½ in. x 6 in. welding plates which were welded continuously on four sides to the 'I' Beam and to the column web. The load was first applied to the top of one 'I' Beam only, very near to the connection—when load reached 106,000 lbs., the column web and flanges began to buckle. The test piece was then reset with a block under each 'I' Beam close to the column web and the load applied directly to the top of the column. A load of 188,000 lbs. was reached without failure, but the test piece was tipped to such an angle as to make the application of further load unadvisable. Column was shifted to come more directly under point of application of the load and a shim placed under one support. The shimmed connection failed at 118,000 lbs., at point where plate was welded to column web. The other connection at the time was taking 78,000 lbs.

Area fraction

$13 \times ½ = 6½$ sq. in. 106,000—16,300 lb. per sq. in. shear."

6.5

This convincing test should certainly prove interesting to welders who are interested in structural steel welding. Acknowledgment is made to Mr. Centers for supplying the above information which will be very useful to welding contractors who may have to make similar tests for the benefit of safety engineers who are in doubt regarding the advisibility of welding on such jobs as the one described.

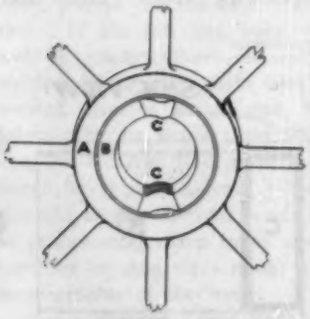
"A point in the favor welding," says Mr. Centers, "we finished the job only 15 minutes behind the erectors, which goes to show where welding is handled in the proper way, the job will be finished on time, just the same as erection of steel and pouring of the concrete."

MECHANICAL TIPS FOR WELDERS

By C. Haeusser

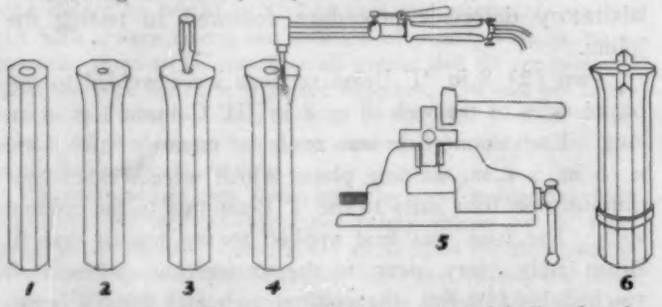
Removing Ball and Roller Bearing Rings

Several of our customers have called upon us to burn out ball bearing rings. It is a well-known fact that pullers and hammers have very little effect on a ring that has been pressed and rolled in tighter by natural action of the balls or rollers. Often it is out of the question to get a grip of any kind on them. A method of getting them loose is illustrated in the accompanying sketch, where A is the steel wheel hub, and B is the ring to be removed. We put a large tip in a welding torch and quickly heat spots on opposite sides of the ring, C, C. When the ring is red hot all the way through it is upset, since there is no chance for it to expand against the cold hub, and becomes too small, so that it will jar out easily when jarred on a cold anvil.



Making Air Drills

Following is an easy way to make or repair hollow steel compressed air drills when you have no special dies for the work. Fig. 1 is a hollow octagon steel. In Fig. 2 the end has been heated and upset by jumping on the anvil. The hole is opened up again by driving in a punch, as in Fig. 3. The corners are burned out, as shown in Fig. 4, with a cutting torch. Fig. 5 shows how to finish with a hammer, in a heavy chipping vise. Fig. 6 shows the finished drill after grinding and welding on the retaining collars. After tempering, a drill made in this manner will give good service.



Driving Rivets With a Torch

A good many garage men bring their ring gears, disc wheel flanges, and automobile frames to our shop to be riveted, because a rivet driven our way sounds solid when struck with a hammer, fills the hole from top to bottom, and never works loose. We use the one-man rig shown in Fig. 1 An exaggerated sketch of a rivet driven the wrong way is shown in Fig. 2. This rivet was heated red hot from end to end in a forge fire and it battered over at the end before the lower part had a chance to swell out and fill the hole. The rivet shrinks lengthwise, causing it to sound solid when struck with the hammer, but it's a poor job because the rivet does not fill the hole. Fig. 3 shows the right way to do it. At A the rivet is first burred over cold, so it will hang suspended while being heated with the oxy-acetylene flame, as at B. Then it is quickly placed on the anvil (C) and struck with a heavy hammer. The hot end of the rivet swells first and completely fills the hole, then the end batters down, and lastly the rivet cools and shrinks, drawing the parts tightly together. The perfectly solid rivet is shown at D.

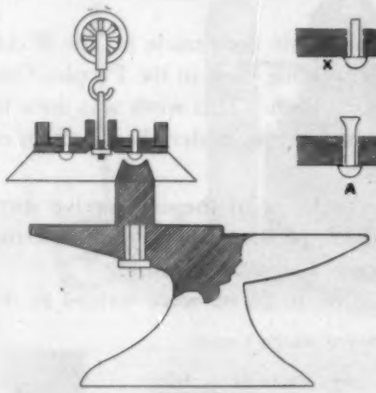


FIG. 2

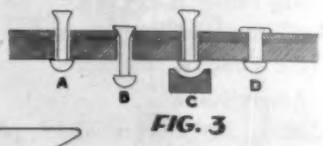


FIG. 3

FIG. 1

A Practical Goggle Stunt

I bought a pair of the best goggles on the market, but they fell short of being just what I wanted. They did not fit my face closely, and the frame interfered with my wearing glasses inside the goggles. The rubber band was inconvenient to use and was soon decomposed by the heat, so that the goggles would not stay in place. Being a resourceful guy, I filed and ground the fiber frame of the goggles to fit my face and allow my glasses to be worn inside. Then I went to a junk yard and got an old broken phonograph spring. I riveted two pieces about nine inches long to the goggles and bent them so they would fit comfortably behind the head. I fixed my respirator the same way, only I used a heavier spring.

JOBS THAT ARE HARD TO LINE UP

By W. F. Novak

In my apprenticeship days I had a great deal of difficulty in lining up some exacting jobs, so I am passing this on to those who are struggling along with this same problem.

To line an elongated lug or projection with an irregular parent casting is a rather difficult problem. To do so successfully and get good alignment simply turn casting so that the break is on top. Balance lug in position and tack weld on two sides then turn casting to convenient welding position and V out with torch and weld.

It is essential that the tack welding be done on two sides to eliminate the warping due to contraction.

This method is accurate and saves considerable time on precision work. I have welded needle valve bonnets by this method and had the needle seat tight. This is ample proof of the accuracy of the method.

BASTIAN & BLESSING MAKING FIRE EXTINGUISHERS

The Bastian & Blessing Co., of Chicago, Illinois, recently added to their line a new product called the Rego Fire Stopper. This device is composed of two main units, a cone-shaped container which is full of dry powder and a small container which is filled with CO_2 gas under pressure. When a fire is discovered the machine is turned upside down, the valve on the gas tank is opened, and the resulting stream of powder directed on the base of the flame. When the fire is out the valve is closed and the tank returned to an upright position.

Welded Display Stands Are Sanitary*

Welder Sells Neat Steel Racks to Grocers and Fruit Dealers to Replace Buckets and Boxes

A NATTY coupe drew up to the curb in front of a grocery store and a lady stepped out to shop. She inspected the fruit and vegetables piled up on baskets and boxes. Street dirt and papers were whirling about them. They looked anything but appetizing, and with a shudder she turned away.

A little further down the street another store was selling exactly the same farm produce. Yet they looked entirely different! Vegetables and fruit were invitingly placed on neat, white steel racks. No dirt could gather around the baskets; no old boxes and crates littered up the premises. Naturally she did her shopping at the second store. Neatness and improved sanitary conditions had sold her.

An enterprising job welder in a small eastern city is doing a thriving business in these racks. They have received the

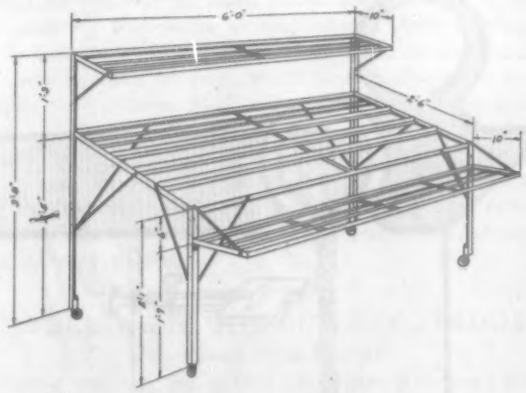


Diagram of Welded Display Stand.

hearty endorsement of the boards of health, merchants, and townsfolk in that section. The success of these stands is great and their use is rapidly expanding, both for inside and outside display.

He makes various styles and shapes, all tailored along the same general pattern. One of the most generally used styles is shown in the illustration. The legs and tray frames are of light angle iron while the cross strips of the racks are steel slats.

Simple jigs are very handy helps when making these stands. One is 5 feet long by 10 inches wide, the other 6 feet long by 30 inches wide, inside dimensions. Cut the side pieces for the jig frames 2 inches shorter than these dimensions in order to leave the corners open for welding the corners of the tray frames. Tack-weld these lengths of light angle iron to a piece of sheet steel, using a square to get them at right angles to each other. The larger jig is for constructing the middle tray, while the smaller one is for the upper and lower trays, as shown in the picture. These jigs, of course, are used over and over again.

These jigs built, you can go ahead and make the stands. Since the ends of the four sides are touching each other, butt-weld each corner by thoroughly melting the edges together, and building up with steel filler rod. Next, take steel bars 6 feet long by 1 inch wide, and weld them to the inside of the ends of the frame, leaving three inches between the slats. The middle tray is now finished.

Weld two corners of the middle tray to the tops of the two front legs and the other two corners to the back legs at point 2 ft. 5 in. from the bottoms. (Front legs are angle iron, 25 in. long; rear legs are 44 in. long.)

Now, with the smaller jig, construct the upper and lower trays in the same way as the middle tray was made. Then weld two corners of the upper rack to the tops of the back legs. Light steel braces should be run from the outer corners to points 10 inches down the legs.

Two good methods of attaching the small lower tray are in use. The simplest is to weld two corners to the front legs 6 inches down from the top and brace from the outer corners to the tops of the front legs. Many, however, prefer to have the lower rack attached with hinges, so it can be folded under while passing through a door or when not in use. The brace is attached to the frame on a swivel or loose rivet, while a hook is put on the other end which locks it over the middle frame when the rack is raised.

Photograph of Welded Display Stand After Completion.

To improve the rigidity of the stand, weld light steel braces from each leg to the frame of the middle rack. For extra heavy loads, center legs would be desirable.

In order to be able to move the stand easily, put castors on the legs. Take a piece of ¾-in. steel pipe about an inch long. In each end weld a small washer, with a hole to fit the post of the castor you use. Insert the castor post through the holes in the two washers, seeing that a snug fit is secured, yet one which will permit the castor to turn easily. Heat the end of the post which sticks out the top and upset it like a rivet head, taking care not to batten it so tight to bind the castor. This is merely to keep the castor from falling out. Then weld the pipe to the angle iron of the legs, with the bottom of the pipe flush with the end of the angle iron.

The stand is now complete. To preserve the steel from rusting, as well as to better the appearance of the stand, clean it and give it a good finish of aluminum bronze, or white or gray enamel.

*Copyright, 1925 by The Linde Air Products Co. Reproduced from The Linde Oxwelder by courtesy of the publishers.

MILBURN OIL BURNER AND PREHEATER

In welding many castings, preheating is necessary to neutralize expansion and contraction strains or to effect economy of gases. Without preheating, complicated castings are liable to develop new brakes at points remote from the weld after the weld itself has been successfully completed. Large castings will absorb a large amount of heat from the welding flame before a local melting heat is attained, so a great gas saving can be made by first preheating the entire piece.

The operations that can be performed economically and advantageously with an Oil Burner and Preheater are very numerous and varied. In Foundries, Boiler Shops, Machine and Repair Shops the uses range from heating soldering irons to burners for Core Ovens, Annealing Furnaces, etc.

Milburn Oil Burner and Pre-Heater.

The Milburn Oil Burner and Preheater is primarily designed to give maximum combustion and greatest heat in the quickest possible time, thereby reducing overhead and resulting in greater output from men and machinery. It is made by the Alexander Millburn Co., Baltimore, Md.

The Milburn Burner is of the atomizing type utilizing economically the cheapest grade of crude, fuel, kerosene oil or distillate and compressed air under pressure varying from 50 to 100 pounds.

The air supply line serves two purposes. While furnishing a direct flow to the burner, the air also maintains a similar pressure in the oil storage tank, creating a greater velocity in the oil feed line thus insuring a positive and uniform flow of both oil and air.

The burner embodies the latest scientific developments. The flow of both air and oil are through straight-line orifices, unhindered by coils or staggered passages. The oil, under pressure, enters the atomizing chamber at right angles to it and in an annular form, while the compressed air flows directly through the center striking the filament of oil and completely atomizing it, then expanding it in a venturi-shaped outlet. Thus a thorough mixing vortex is set up, producing an intimate and perfect mixture of both oil and air which insures complete consumption and maximum heating value at the flame. No particles of fuel are blown through the flame unconsumed. There is no siphoning effect of either oil or air. Immediately upon opening the valves the gas at the burner can be ignited and the work at hand can be started. The makers claim carbonization and oxidation are absolutely eliminated.

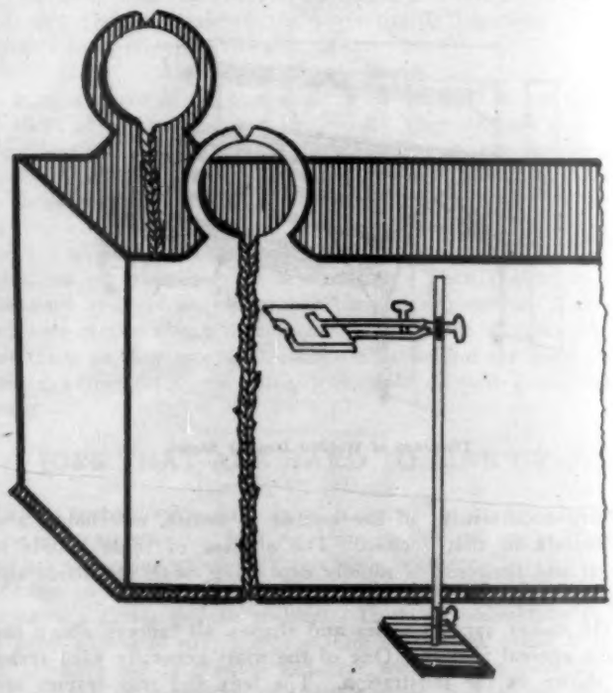
WELDING A BULL DOZER FRAME

By A. W. Young

FOR the information of those who have never seen a bull-dozer, will say the frame is somewhat similar to a stationary engine, only much deeper up and down. The one I had occasion to handle was in a railroad shop in Michigan. The break was on both sides, extending from the base up through the shaft bearings, as shown in the sketch.

In cutting out the V do not cut through; allow one eighth inch on inside of crack, to remain. Don't take a chance on the base cocking up on contraction. In a job of vertical welding on cast iron it is always best to have a retaining wall on outside of the V, as good puddling of the iron cannot be had without it.

I will now describe the making of a rising retainer that can be used on any job of vertical work in cast iron. It is a time saver and well worth the making. Take two round rods about ¾ in. thick, one five feet long and the other four inches long. Have one end of each hammered flat, drilled and threaded for thumb screw. Have a flat block of iron or steel about 10 in. square and 2 in. thick; drill and thread hole in center of same for 4 in. piece of rod which is threaded. Attach the long rod with thumb screw, which can now be swung to any angle to conform to any angle of break in any job.



Use of Carbon Block.

Take a piece of pipe or any metal spool 2 in. long that will slide up and down easily on the rod, drill and thread for thumb screw.

To make a clamp take two pieces of flat metal ¼ in. by 8 in. long, heat one end of each and twist quarter turn, heat and bend these two jaws at twist so that when both are horizontal they will be ¾ in. apart. Drill holes in both at twist end to set in rivet. Weld the under jaw to the spool and rivet on the upper one. Close to the twist ends drill through jaws and thread for thumb screw. On opposite ends weld on 2 pieces 3 in. long of same bar as jaws, at right angle to jaws, giving a broad grip. Take a block of carbon 1 in. thick and grind out one end concave to the necessary width to cover the width of the V. This of course gives extra thickness to the weld. Place carbon in the 3 in. clamp. You will now have a tool that will quickly raise the carbon block as the welding progresses and travel at any angle. Another use to which this can be applied is when blocking up on underside of any weld is

desired. Take out carbon block, clamp in a piece of plate metal of size desired. This makes a shelf on which you can place carbon, brick or metal as desired; run it up quickly to fit snugly on under side of weld, instead of hunting around for bricks, block of iron, and thin pieces to get the exact height. If the parts to be welded are loose and not attached to anything, this shelf gives a support to both ends. If parts to be welded form an angle or curve, the shelf can be raised until the proper alignment is had.

We now turn attention to the job of welding. As the base is a box shape it is easy to build a fire inside. Start with charcoal and gradually work on a good bed of coke. As there is a large area to be heated, coke is desirable on account of greater heat and lasting quality. Only air blast the fire to get it well started and then let the frame heat up gradually, so expansion is not obtained too quickly. A job of this kind requires a welder on each side so as to equalize the heat and contraction, otherwise while welding one side the other crack might be sprung wide open. It is desirable to have a helper who can raise risers as work progresses, and see that one welder does not get ahead of the other, because, being on opposite sides of frame they cannot keep track of each other's work. When welding has reached the shaft bearing, after welding across bottom of it up to within 5/8 in. of bottom of circle, finish up to the bottom by brazing; also braze top of circle with bronze. In any job of welding which requires finishing by machine or hand work, always make it as easy as possible for this to be accomplished. These bearings are quite a distance from the floor so it would be quite a job to bury them in ashes or sand, which should always be done on cast iron that is to be filed or machined; otherwise you take chances of the exposed weld becoming chilled too hard to work. In using bronze you make sure on this job that inside of bearings can be easily smoothed up. Have open top of frame covered with sheet asbestos, which will help retain the heat, as an extra slow cooling down is desirable so contraction comes on very slowly.

ARC WELDING IN THE BUILDING INDUSTRY

(*Continued from page* 21)

transmitted through the welded point that connected the vertical and horizontal members, more severe in fact than any structure would be expected to stand in practice, and yet the welded joints did not fail.

Summary

Arc-welded joints in structural-steel members are proven strong enough to remain intact while the structural-steel members were badly deformed under a static load of 40 tons.

When subjected to vibration of 1760 reversals per minute, arc-welded joints surpassed standard riveted joints in performance and showed a longer life than the structural material joined by it.

Under a sudden shock produced by a blow of approximately 700 tons, the arc welds in a test piece did not fail even though the structural-steel members were severely strained and deformed.

Conclusion

From the results of the foregoing tests, it is concluded that arc-welded joints in structural steel are capable of withstanding any stresses that the structural members will withstand without deforming, and will remain intact even after the structural members are deformed or broken. Under a steady pressure and under shock, the welded joints are capable of remaining intact even though the structural-steel members that they unite are badly deformed. Under vibration, contrary to the expectation of many, the arc-welded joints do not fail, nor do the failures in the surrounding steel appear to be due to rearranged structure resulting from the welding.

In regard to the cost of making these joints, it may be said a 3/16" fillet weld as used in these joints can be put in for between 15 cents to 20 cents per linear foot of bead, depending upon the position of the work. This is based upon labor at $1.00 per hour, wire at 10 cents per pound and electrical energy at .02 cents per kwh.

G. P. A. AND C. G. M. A. CONVENTIONS THIS MONTH

Arrangements have been completed for the annual winter meeting of the Gas Products Association, which is to be held at the New Palmer House, Chicago, January 20, 21 and 22. The speakers on the program have much of interest to tell both the manufacturers and users of oxygen and acetylene, and C. T. Allen, secretary of the Association, states that the activity of several important committees promises to result in unusually interesting reports and discussions. The advance reservations made by members living in distant cities indicates a splendid attendance.

Many of those who attend the G. P. A. meetings will leave Chicago Sunday, so as to arrive in New York Monday, January 25, for the annual meeting and dinner of the Compressed Gas Manufacturers' Association, which has been well promoted by an energetic secretary and entertainment committee.

CORRECTIONS

A few errors in the December issue of *The Welding Engineer* have been called to our attention and we take this occasion to note the corrections.

On page 45 the photograph which is supposed to represent a locomotive cylinder is a picture of a cylinder from a hoisting engine which was welded by the Quick Welding Machine Co. of Terre Haute, Ind. This was included in the series by a mistake.

On page 43 the second sub-heading which reads, "A Use for Carbonizing Plants," should read "A Use for the Carbonizing Flame."

On page 41, the first paragraph below the banquet picture should read "Acetylene: Beacon of Progress, by E. E. Thum, Linde Air Products Co".

WELDED 1650 FEET UNDERGROUND

With Oxy-Acetylene Equipment Metal Mine Builds Steel Tank in Unusual Location

By J. J. Burton

Being accustomed to rely upon their own resources for nearly everything, especially when the repair of equipment of the production of special apparatus is concerned, it is not surprising that mining men generally have accepted the oxy-acetylene process of welding and cutting as dependable insurance against delay and shutdown. Repair of heavy equipment is an old story to them; the matter of days or even weeks saved by welding an important casting is now relatively commonplace. Saving hundreds of dollars through repairing a piece of equipment that might otherwise go to the scrap pile is now looked upon as an ordinary incident in mine operation.

The Oxy-acetylene welding process, however, is also adapted to construction of special equipment. It is often said that with welding and cutting equipment the welding operator can work with metals just as a carpenter works with wood; cutting here and joining there as building of the part demands. Light, easy portable, this apparatus can be used wherever a man can work.

Portability, adaptability to unusual purposes and convenience were strikingly demonstrated recently at a mine in Arizona.

Here a spring of pure water was found on the 1300-ft. level. Unlike most mine water, it contained no minerals which rendered it unfit for use; it analyzed pure enough to be used even as drinking water. For this purpose and for use with various machines, it was desired to run the spring water into a tank.

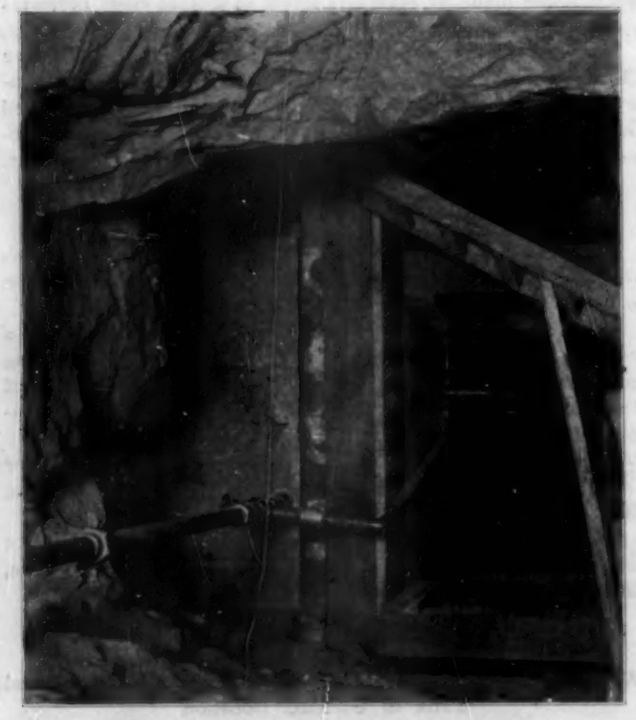
The best location was in a drift from the main tunnel on the 1630-ft. level. By blasting out the drift at the end, and by running a raise up for a few feet, a room for the tank was made. The tank was to be of 1600-gal. capacity, 6 ft. on each side, built of 1/4 in. boiler plate.

A tank of this size and weight could not be built on the surface

and lowered underground—the shaft wasn't big enough. It was therefore necessary, if the tank were to be had at all, to build it in place.

A rivited tank was out of the question; there wasn't room to work outside and inside at the same time. The mine used Oxweld welding and cutting apparatus extensively in both their surface and underground operations, so it was promptly decided to weld the tank underground.

A platform was first built in place, Boiler-plate sections were cut to size and prepared for welding in the boiler shop on the surface, and were lowered to the 1650 ft. level. Here they were put into position on the platform and welded. In order to make the welding as convenient as possible under the cramped condi-



1000 Gallon Tank Welded 1650 Feet Underground

tions (there was a clearance of only 1½ ft. between the side walls of the tank and the drift), the tank was arranged so that it could be swung around in various positions to give the welder as much room to work in as possible. Welding was not a very comfortable job, as on this level the normal temperature is 122 deg. F.

It took three 8-hour shifts for one welder and helper to do the work. When the tank was completed it was found to be tight in every seam and perfectly square. In addition to the seams, all nipples and pipe connections in the pipe were welded. The entire cost was about $150.00.

A 2 in. hole was drilled with a diamond drill from the spring on the 1300 ft. level to the tank, and a pipe was run to the tank from the spring. The building of this tank illustrates in a striking manner both the resourcefulness of the mine management and the adaptability of gas welding to unusual conditions.

WELDING STORAGE TANKS ARE SAFE

(*Continued from page* 24)

5-pound hydrostatic pressure, then release the pressure. This was done twenty times to correspond to the filling and emptying of the tank. This seemed to have no affect on the tank so they decided to see how much pressure it would stand. The opinion of most of the spectators was that the tank would burst at 25-pounds pressure.

"First they piled 1,200 pounds of cement on top of the tank to represent the weight of the earth when in service underground. Then they ran city pressure of 75 pounds without being able to detect any sounds of leakage in the tank. Finally the air pressure was applied until the tank burst at 179 pounds.

"The remarkable feature developed in this test was that all of the welds held, even small tacks in the reinforcement. The only place where it split from welding was where a nipple had been welded in.

"The fact that the split in the sheet was 2 inches from any welding is a sufficient indication that the welding was fully as strong as the original sheet."

"The photograph which I am sending along to illustrate this article shows the tank just before it burst. Note the way the head is bulged out. This was a flat head originally. Also note the way the center of the tank is bulged out. The pressure expanded the tank as follows: The heads were bulged out 3 inches and the metal expanded 9.4 per cent, causing a total increase of 11⅝ inches in the circumference.

"I have never seen a riveted tank subjected to a test of this sort, but I am very sure that it would not stand the test as well as the one just described."

NEW FEATURES OF BURDETT APPARATUS

The Burdett Manufacturing Company, 309 St. Johns Court, Chicago, now equip all their Sta-Set Regulators with a dirt collector built into the regulator body, which prevents fine particles of scale and dust lodging on the seat and causing leakage. The dirt collector, though of ample area to provide for long use without cleaning or affecting gas flow, may be opened and cleaned without dismantling the regulator.

It has also been announced that the Type 2830 Cutting Torch is made with single tube extension for strength and appearance, with the mixing device placed midway between the handle and the head, to provide cooler operation. The mixing device has also been improved, and is said to give a better mixture, with greater economy as well as increased range and speed. The latter features are obtained, too, from the large volume of high pressure oxygen.

NEWS OF THE WELDING TRADE

H. C. Houck, formerly assistant general merchandise manager of the General Electric Company, was recently appointed manager of the merchandise department at the Bridgeport, Connecticut, plant.

It is reported that the Seneca Wire & Mfg. Co., Fostoria, Ohio, is planning a new one-story factory.

The Page Steel & Wire Co. recently appointed Horace T. Potts & Co., Philadelphia, distributors for Maryland and the District of Columbia. A new branch office of the Potts company has been opened in Baltimore.

The Greenwood Welding Co., Greenwood, S. C., are reported to be preparing a plant for the production of bobbins for the textile trade.

Extensions and improvements planned for the Buffalo plant of the Wickwire-Spencer Steel Corporation are estimated to cost in excess of $100,000.

Adolf Messer, manufacturer of Messer oxygen production plants in Germany, is on his way to the United States and is expected to arrive in Chicago about Jan. 20. Mr. Messer may be reached through the Keith Dunham Company during his stay in America.

A beautiful calendar for 1926 has been received from the Maryland Welding Company, Baltimore, Maryland. Calendars are said to be a very good method of advertising the welding shop. The one mentioned is exceptionally attractive.

In charge of exhibits at the Road Show in Chicago this month were C. R. Pollard, of the Alexander Milburn Co., and W. T. Kyle and W. H. Bleecker, of the Page Steel & Wire Company.

G. L. Hulben has been added to the sales force of the Chicago Branch of The Ludlum Steel Co., General Offices and Works, Watervliet, N. Y. For years Mr. Hulben has been connected with the Chicago Sales Division of a large tool steel manufacturer and is a very popular and capable man in the territory.

CURRENT WELDING LITERATURE

WELDING WIRE FOR IRON AND STEEL.—A review of the paper read by J. R. Dawson at the recent Convention of the American Welding Society in Boston, giving a description and uses for a new filler material called "high test welding rod."—Revue de la Soudure Autogene, November.

APPLICATIONS OF OXY-ACETYLENE WELDING IN CONSTRUCTION.—Photographs and comments showing the construction of window sashes from sheet metal.—Revue de la Soudure Autogene, November.

THE PROGRESS OF OXY-ACETYLENE CUTTING.—An article describing the developments and various uses of the cutting process including mechanically operated cutting torches. Also points out that while the operation is a simple one, the great majority of operators do not know how to handle it to the best advantage.—Revue de la Soudure Autogene, November.

CUTTING SALAMANDERS AND HEAVY MASSES OF IRON WITH AN OXYGEN LANCE, by E. E. Thum.—The oxygen lance is a steel pipe passing a stream of pure oxygen. It is widely used in blast furnaces and steel plants for drilling holes in large masses or blocks of iron or steel.—Blast Furnaces and Steel Plant, January, 1926.

EFFECT OF HEAT OF BRONZE WELDING ON CAST IRON PIPE, by Arthur R. Lytle.—Bronze welding of cast iron and steel has been recognized as a commercial process for only a few years. Micro photographs are used to show the heat effects on the structure of the metal—Acetylene Journal, January.

INFLUENCE OF OXY-ACETYLENE CUTTING ON STEEL FOUNDRY PRACTICE, by R. W. Thomas.—In addition to removing risers from castings much cheaper than by old processes, the cutting torch through its flexibility has made it possible to design and produce castings in more economical and improved ways. The process is said to be directly responsible for improving the quality of castings.—Acetylene Journal, January.

STAMPINGS ASSEMBLED BY WELDING, by L. S. Love.—The perfection of the welding processes has made it possible to use them in replacing other methods for manufacturing and assembling metal products. The use of special jigs has solved many of the production welding problems.—Iron Age, January 14th.

THE MANUFACTURE OF OXYGEN, by A. Edgar Knowles.—Discussion of a paper read before a recent meeting of the Institution of Welding Engineers, London, on the subject of the manufacture of oxygen with special reference to its production by the electrolytic method. The discussion was carried on by representatives of several prominent British oxygen manufacturers.—The Welding Journal, London, December.

AUTOGENOUS WELDING OF COPPER BY THE OXY-ACETYLENE PROCESS, by A. Eyles.—Characteristics of copper especially when in the molten state. Flux is not necessary. Precautions to be taken in making sound welds. Welded joints and other preparation.—American Machinist, December 31st.

ARC WELDING REDUCES MAINTENANCE COSTS, by A. M. Candy.—The equipment and facilities for welding in the shops of the Worcester Consolidated Street Railway are very complete. Welding booths are arranged in a row between the overhauling pits and the machine shop.—Electric Railway Journal, December.

Classified Ads

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For Sale—We still have available service rights on a few W.K. and W.C. Prest-O-Lite Cylinders. Address Remington Arms Co., Inc., Bridgeport, Conn.

Wanted—The name and address of every gas and electric Welder in America. Knight Bros., 113 S. Oakley Blvd., Chicago, Ill.

Harry Love Is Wanted at Home—His family is trying to get in touch with him. They are in trouble and need help. Write to M. Hayter, 388 5th St., Apt. 1, San Francisco, Calif.

Wanted—Position, by welder with nine years' experience. Gas and Electric. Carnegie Tech graduate. Address, Welder, 8213 Carnegie Ave., Cleveland, Ohio.

For Sale Cheap—Slightly used two Davis-Bournonville acetylene generators, with gauges and valves. 200 cubic feet capacity, loading 200 pounds. Tampa Shipbuilding & Engineering Co., Tampa, Florida.

For Sale—General blacksmithing and oxy-acetylene welding shop, now doing good business in large city. Owner's poor health forces him to take outside job. Address 81, care The Welding Engineer.

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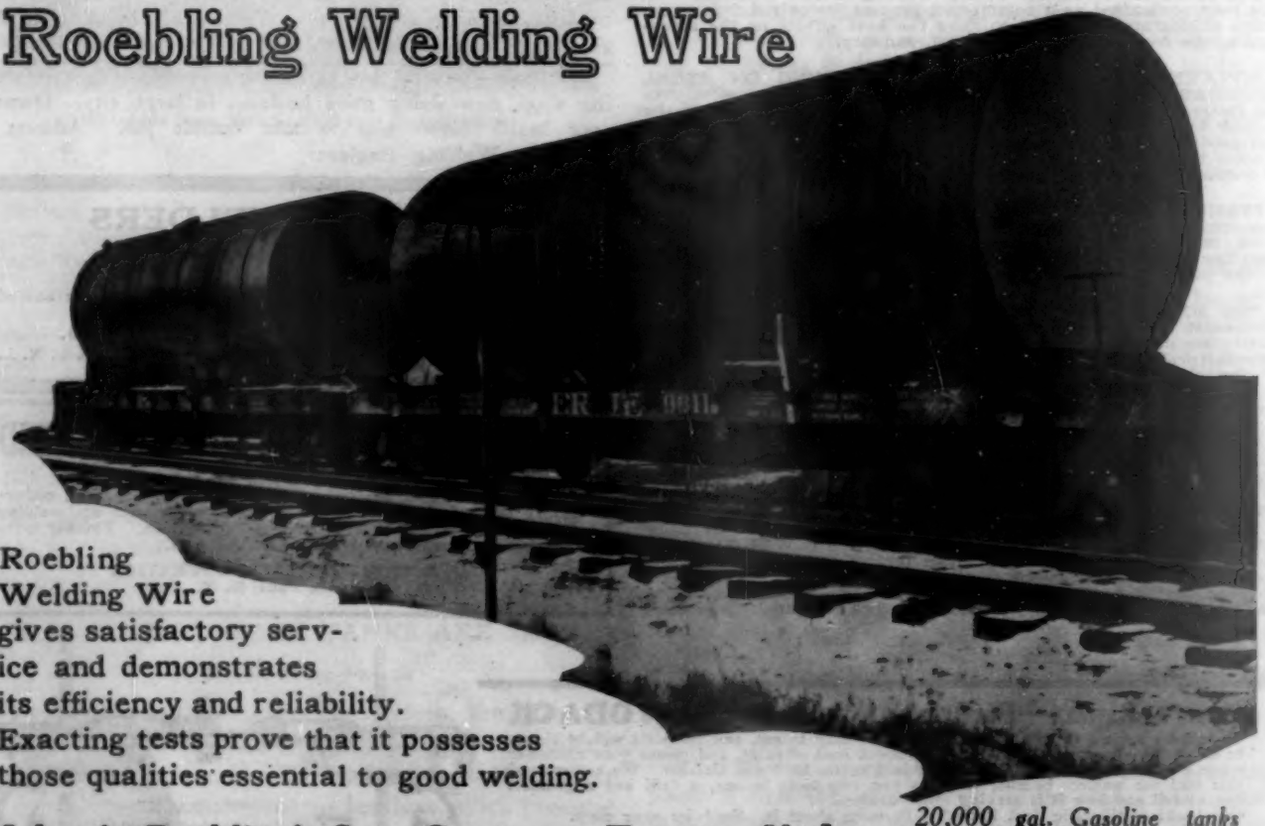

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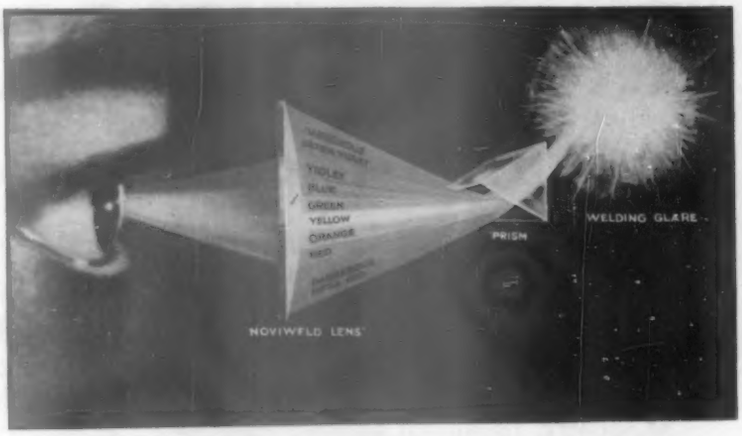

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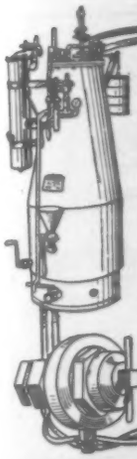

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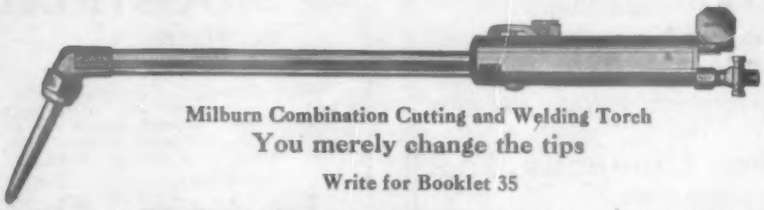

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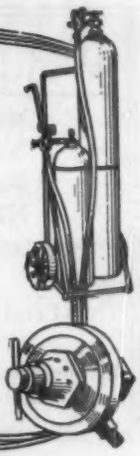

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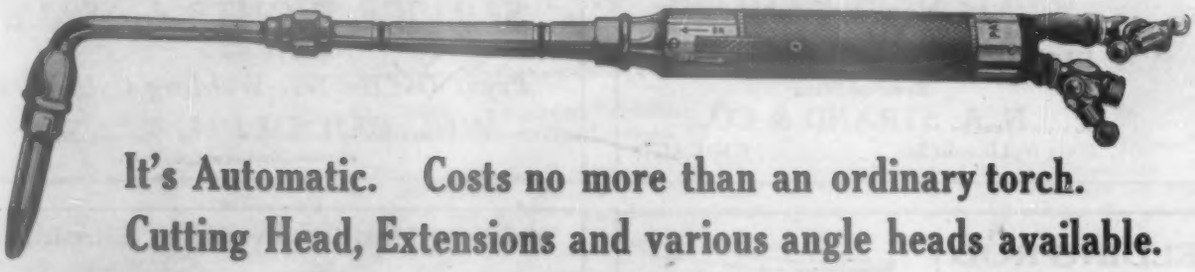

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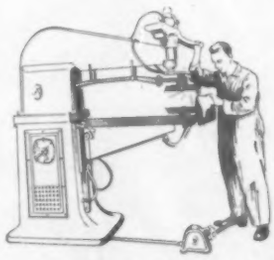

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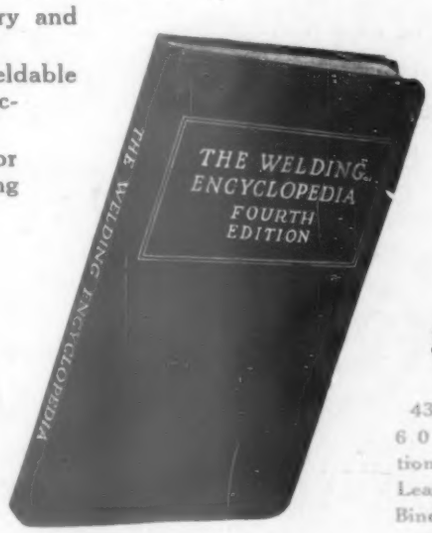

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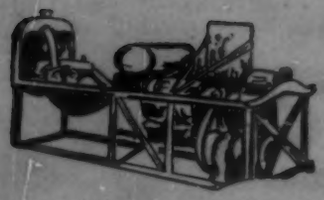

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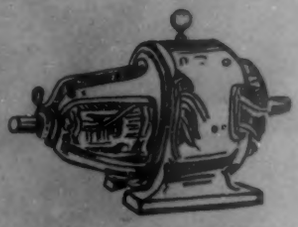

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